Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	AK
Project Title	Sea Grant Climate Adaptation 2011: Shaktoolik Alaska – Climate Change Adaptation for an at-risk Community
Investigators	Gay Sheffield (Alaska Sea Grant); Terry Johnson (Alaska Sea Grant);
Partner	City of Shaktoolik; Kawerak, Inc.; Native Village of Shaktoolik; Shaktoolik Native Coorporation;
Description	All of the project activities and deliverables are designed to directly benefit the Alaska community at risk from climate change impacts, and by extension, similar communities in the region by providing useful information and a process model for their consideration. The specific benefits will include: information about adaptation measures that can be implemented in an Arctic community, an evaluation of current relocation efforts of Alaska communities, on-site advice from the Newtok tribal administrator about his relocation efforts, roundtable discussions with community representatives and experts in a variety of subjects, climate change information and planning tools from Sea Grant, a list of funding sources, and completion of an adaptation plan for the Community of Shaktoolik. This project will benefit other coastal communities facing risks from climate change in two primary ways. First, research from the project will be made available to other at-risk communities, including the documents on adaptation measures (Activity #1), lessons learned from relocation efforts of Alaska communities (Activity #2), and analysis of potential funding source for adaptation measures (Activity #4). Second, other coastal communities will benefit from the process developed by Shaktoolik for making decisions about climate change adaptation (Activity #11).
Progress	
Summary	

Program	AK
Project Title	Alaska Sea Grant Community Environmental Hazard Response Resources: Online Information and Training
Investigators	Paula Cullenberg (Alaska Sea Grant);

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Partner	Alaska Native Tribal Health Consortium; Alaska Ocean Observing System (AOOS);
Description	Alaska Sea Grant, together with appropriate partners, proposes to develop two new websites to provide resources for Alaska coastal communities facing climate-driven or other environmental changes. The first site will be developed in partnership with an existing network of trained, community-based environmental observers. It will provide those observers with access to timely information, expertise and training as they encounter new or changing natural phenomena in their communities. The second site will provide a central registry of, and forum for, numerous "citizen science" community-based environmental programs, enabling an enhanced awareness of programs statewide and fostering exchange of information, ideas, and best practices.
Progress	
Summary	

Program	CA
Project Title	California Sea Grant Climate Adaptation Capacity Building
Investigators	Monique Myers (California Sea Grant Extension Program); Richard M. Starr (California Sea Grant Extension Program);
Partner	California Coastal Commission (CA RESOURCES, CCC);
Description	The National Sea Grant minibus proposal provides an opportunity for California Sea Grant to develop a partnership with the California Coastal Commission (CCC), the state's primary coastal planning body. Generally, the goal of this project is to begin the process of developing capacity throughout California to help provide coastal communities with information to make better informed decisions, and ultimately develop and implement customized solutions to the hazards and climate change challenges which threaten their economic, environmental, and social well-being. Specifically, our goals for this proposal are to build capacity within California Sea Grant and the California Coastal Commission (CCC) by funding a Sea Grant Extension Fellow to work with the CCC. Our project objectives include: 1) Collaborate with the California Coastal Commission to develop an agreement to accept and partially pay for a California Sea Grant Extension Fellow, 2) Advertise and select a recent postgraduate to accept the Fellowship, 3) Conduct an initial meeting with

	California Coastal Commission leaders and California Sea Grant Extension Advisors to define a project of mutual interest that is related to extension of climate change adaptation information to coastal communities, 4) Identify and try to engage local experts as well as tapping NOAA and other regional and national experts to support the project, 5) Conduct outreach to coastal communities to support the project, 6) Attend a national climate extension meeting to be held in late 2012 or early 2013, 7) Periodically meet with California Coastal Commission leaders and California Sea Grant Extension Advisors to adaptively manage the project so the climate change adaptation information reaches as many communities as possible. Our target is to provide information/training to 1--5 coastal communities each year of the grant.
Progress	RELEVANCE: Former CA Gov. Arnold Schwarzenegger in 2008 signed an Executive Order (S-13-08) directing state agencies to develop a strategy for adapting to climate change. RESPONSE: With partial support from California Sea Grant, nearly 600 California coastal planners and managers were surveyed on their attitudes and knowledge about climate change, their technical needs in meeting state directives and progress toward implementing "climate adaptation" policies. Responses form the basis for the report "Rising to the Challenge: Results of the 2011 California Coastal Adaptation Needs Assessment," presented to state agencies (see partners). RESULTS: Based on the survey responses, the California Ocean Protection Council is directing $2.5 million to help coastal communities update their coastal plans and brace for rising sea levels. NOAA Coastal Services has incorporated some of the report's findings into its "Climate Adaptation for Coastal Communities" 3-day training program.
Summary	A survey of coastal professionals led by USC Sea Grant in partnership with California Sea Grant is helping California's coastal communities plan and prepare for rising sea levels and other impacts of climate change.

Program	CA
Project Title	Consequences of Nearshore Low Oxygen and Low pH for Coastal Resources of Southern California
Investigators	Ed Parnell (University of California, San Diego, Scripps Institution of Oceanography); Lisa Levin (University of California, San Diego, Scripps Institution of Oceanography); Todd Martz (University of California, San Diego, Scripps Institution of Oceanography);
Partner	California Department of Fish and Wildlife (CA RESOURCES, CA DFG); California Wetfish Producers Association (CWPA); Southwest Fisheries Science Center (US DOC, NOAA, NMFS, SWFSC);
Description	The upper boundary of the ocean's oxygen-minimum zone has shoaled by at least 90 meters in the last several decades in the Southern California Bight. Observations of dissolved oxygen and pH suggest that these waters are now being

	advected into nearshore habitats during intense upwelling events, exposing commercially important species—crabs, lobster, urchin, rockfishes and squid—to potentially hypoxic, corrosive waters. This project will investigate: (1) the effects of low-oxygen, low-pH conditions on nearshore biota in Southern California, using monitoring data off San Diego County; and (2) the market squid (California's most valuable commercial fishery) as a case study of the region's potential vulnerability. From the monitoring data, scientists will, among other things, assess the frequency, duration, and severity of low-oxygen, low-pH episodes off the coast (to 200-meters depth). Laboratory experiments will be conducted to evaluate the effects of these conditions on benthic squid egg development. GIS maps of oxygen and pH "stress" will then be superimposed onto benthic habitat maps showing where squid typically lay their eggs to identify areas where squid reproductive success may be compromised. Results from this project begin the process of using monitoring data to make highly localized species-specific predictions on the potential consequences of hypoxia and acidification to biological resources.
Progress	
Summary	

Program	CA
Project Title	Response of Calcified and Fleshy Macroalgae to Warming and Ocean Acidification: from Single Species to Community Interactions
Investigators	Jennifer Smith (University of California, San Diego, Scripps Institution of Oceanography); Michael Graham (Moss Landing Marine Laboratories); Scott Hamilton (Moss Landing Marine Laboratories);
Partner	Ocean Discovery Institute, San Diego State University (SDSU); University of California, San Diego, Scripps Institution of Oceanography;
Description	Do plants like CO2? Researchers generally expect land plants to grow larger as CO2 levels rise. The responses of marine algae, kelp and seaweeds are more difficult to predict, however, since the ocean will become more acidic as it absorbs more of the gas from the atmosphere. This project will test the responses of coralline (calcified) algae and fleshy seaweeds (red and brown) to an ocean that is both warming and more corrosive. Experiments will be conducted on individual species to quantify changes in growth, calcification and photosynthetic performance, and on assemblages of species to investigate competition effects. Because coralline algae are often settlement habitat, researchers will also examine whether acidification alters the chemical cues emitted by the algae and their detection by red abalone larvae.

	Results further both state and federal goals of managing marine ecosystems in the face of climate change. In addition, scientists plan to develop K-12 classroom curricula about climate change in marine ecosystems.
Progress	
Summary	

Program	DE
Project Title	Enhancing community awareness of future flood risk and vulnerability through use of mapping visualization tools
Investigators	Wendy Carey (University of Delaware (UDEL));
Partner	
Description	Mapping visualization tools provide one of the best ways of representing and communicating flood risk and vulnerabilities, and are useful for mitigation planning and implementation of adaptation strategies. In the future, an increasing percentage of Delaware's coastal population will be threatened by flooding due to rising sea levels and the increased frequency and magnitude of extreme storm events. Existing floodplain maps depict current or past risk, and are based on historic data. New mapping technologies can be more effective than existing floodplain maps for communicating risk because both present and future levels of flood risk can be depicted. The proposed project includes development of community flood visualization maps for several Inland Bay communities, as well as Delaware City, adjacent to Delaware Bay. Various flood scenarios will be included in the visualization maps, including the 100-year floodplain plus one- to two-feet of additional flooding which will serve as depictions of future flood risk from storms and/or sea-level rise. 1) Community flood visualization maps will be created depicting floods of the recent past as wells as how potential sea level rise scenarios may impact water levels and will be developed through a combination raster and vector data analysis using the best available LiDAR derived elevation and FEMA flood map data. Data to be included on the maps include FEMA's 100 year floodplain plus 1-2' of additional flooding. For geographic areas where high water mark data is available, 1998 northeaster flood levels will also be incorporated. Updated flood information from FEMA's new coastal floodplain maps will be incorporated when available (2012/2013). 2) Evacuation route profiles will be created depicting the 10-year and 100-year floodplain plus 1-2' of additional flooding. 3) Meetings and workshops will

	be convened with DelDOT, DEMA, Sussex County Emergency Management officials, and community representatives to inform and extend the map visualization tools. 4) Information and guidance related to planning for future flood risk will be added to the Delaware StormSmart Coasts and Delaware Sea Grant websites. This project will enhance hazard mitigation planning, emergency response, and public awareness through improved flood visualization products. The maps and evacuation route profiles will provide critical flood and coastal hazard information to end users and will be useful awareness and disaster preparedness tools for individuals and communities. The ability to visualize the potential depth and inland extent of water and inundation impacts provides a better understanding of impacts and consequences of future flood risk, no matter what the cause.
Progress	Management effort provided long-range planning, overall program direction, required reporting, and policy through quarterly and ad hoc meetings of the management staff. In support of the Omnibus proposal the DESG management team completed the Omnibus submission process. Two meetings were held (spring and fall) with the Delaware Sea Grant (DESG) management team and the Delaware Sea Grant Advisory Council (DE SGAC). Applications for both the Coastal Management and Dean John Knauss Marine Policy fellowships were solicited, reviewed, interviews completed, and final submissions made for both the Delaware applicants and three applicants from Washington, DC, in accordance with an agreement between the National Sea Grant Office, and the Virginia and Maryland Sea Grant Programs. Applications for funding under the National Sea Grant Office Aquaculture NSI were solicited, PI inquiries were addressed, and proposals were submitted to the National Office. Three members of the DESG Management Team participated in Sea Grant Week, 2012 to increase collaboration and communication across the Sea Grant Network. The 2014-2016 Request for Proposals (RFP) was developed from the content of the new strategic plan, with renewed attention to the outreach efforts associated with research based largely on a review of Sea Grant network 2012-2014 RFPs. Data management plan guidance was developed and included to reflect the new NOAA guidance and ensure the DESG 2014-2016 Omnibus will be in full compliance. The Management Team worked with six Sea Grant programs (NY, NJ, PA, MD, VA, NC) to establish the Mid-Atlantic Sea Grant Regional Research competition for the 2014-2016 Omnibus. The Management Team again secured FY2013 funding from the Delaware Legislature, with a slight increase over prior years to $564,000.
Summary	

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Project Title	Enhancing community awareness of future flood risk and vulnerability through use of mapping visualization tools

Investigators	Wendy Carey (University of Delaware (UDEL));
Partner	
Description	Mapping visualization tools provide one of the best ways of representing and communicating flood risk and vulnerabilities, and are useful for mitigation planning and implementation of adaptation strategies. In the future, an increasing percentage of Delaware's coastal population will be threatened by flooding due to rising sea levels and the increased frequency and magnitude of extreme storm events. Existing floodplain maps depict current or past risk, and are based on historic data. New mapping technologies can be more effective than existing floodplain maps for communicating risk because both present and future levels of flood risk can be depicted. The proposed project includes development of community flood visualization maps for several Inland Bay communities, as well as Delaware City, adjacent to Delaware Bay. Various flood scenarios will be included in the visualization maps, including the 100-year floodplain plus one- to two-feet of additional flooding which will serve as depictions of future flood risk from storms and/or sea-level rise. 1) Community flood visualization maps will be created depicting floods of the recent past as wells as how potential sea level rise scenarios may impact water levels and will be developed through a combination raster and vector data analysis using the best available LiDAR derived elevation and FEMA flood map data. Data to be included on the maps include FEMA's 100 year floodplain plus 1-2' of additional flooding. For geographic areas where high water mark data is available, 1998 northeaster flood levels will also be incorporated. Updated flood information from FEMA's new coastal floodplain maps will be incorporated when available (2012/2013). 2) Evacuation route profiles will be created depicting the 10-year and 100-year floodplain plus 1-2' of additional flooding. 3) Meetings and workshops will be convened with DelDOT, DEMA, Sussex County Emergency Management officials, and community representatives to inform and extend the map visualization tools. 4) Information and guidance related to planning for future flood risk will be added to the Delaware StormSmart Coasts and Delaware Sea Grant websites. This project will enhance hazard mitigation planning, emergency response, and public awareness through improved flood visualization products. The maps and evacuation route profiles will provide critical flood and coastal hazard information to end users and will be useful awareness and disaster preparedness tools for individuals and communities. The ability to visualize the potential depth and inland extent of water and inundation impacts provides a better understanding of impacts and consequences of future flood risk, no matter what the cause.
Progress	Using Site Review Team input, strategic planning began in the fall of 2011 with Delaware Sea Grant Advisory Council discussions, followed by public surveys were distributed via the internet to identify public concerns about Delaware's coastal economy and ecosystems, and develop focus areas for strategic planning. A stakeholder workshop was held to review the survey input, foster discussion, and identify priorities for the 2014-2017 Strategic Plan. Upon release of the draft National Sea Grant Strategic Plan, the Delaware Sea Grant management team composed comments for

	consideration by the National Sea Grant Office, and incorporated appropriate alignments into the draft 2014-2017 Delaware Sea Grant Strategic Plan. The Delaware plan was submitted to the National Sea Grant Program and approved. The PRP process was completed, with submission of data to PIER and completion of a 20-page PRP Summary document, and submission of response comments upon receipt of the PRP final report.
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Progress	A collaborative project has been initiated to develop map products that depict community flood risk and vulnerabilities. Project partners include Delaware Department of Natural Resources and Environmental Control (DNREC) and U. S. Geological Survey (USGS), with additional input from the Sussex County Emergency Operations Center and the community of Delaware City. Discussions have been held regarding available data sets that could/should be used in depictions of 100-year floodplain plus one- to two-feet of additional flooding for project sites including Delaware City and low-lying areas surrounding Delaware Inland Bays – Rehoboth, Indian River, and Little Assawoman Bays. Consideration will also be given to using newly developed DFIRM data that will be available in January 2013. The project planning meetings have also included discussions of evacuation route elevation profiles referenced to various flood heights, coordination with partner agencies such as DelDOT, DEMA and Sussex County Office of Emergency Management, as well as final map products and outreach strategies. In the aftermath of Hurricane Sandy, site visits were conducted to several possible study locations in Sussex County adjacent to Rehoboth, Indian River and Little Assawoman Bays, including Oak Orchard, Pot Nets, Long Neck, south side of Indian River Bay, and Fenwick Island bayside.
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	products that include coastal flood hazard analysis maps for New Castle and Sussex counties. The project planning meetings have also included discussions of evacuation route elevation profiles referenced to various flood heights, coordination with partner agencies such as Delaware Department of Transportation, Delaware Emergency Management Agency and Sussex County Office of Emergency Management, as well as final map products and outreach strategies. In the aftermath of Hurricane Sandy, site visits were conducted to several possible study locations in Sussex County adjacent to Rehoboth, Indian River and Little Assawoman Bays, including Oak Orchard, Pot Nets, Long Neck, south side of Indian River Bay, and Fenwick Island bayside.
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Partner	
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Progress	An increasing percentage of Delaware's coastal population will be threatened by future flooding due to rising sea levels and the increased frequency and magnitude of extreme storm events. Existing floodplain maps depict current or past risk, and are based on historic data. New mapping technologies can be more effective for communicating present and future risks/vulnerabilities, and are useful for adaptation strategy implementation and mitigation planning. Maps are currently being developed for Delaware City using the best available LiDAR-derived elevation in combination with the latest FEMA flood mapping products and high water elevations associated with historic events to create a series of community flood visualization maps. Additionally, evacuation route profiles were created to depict the 10-year and 100-year floodplain plus 1-2' of additional flooding (meant to depict potential sea-level rise impacts). Delaware City is planning to incorporate these visualization maps into their on-going hazards/climate adaptation planning project.
Summary	

Program	DE
Project Title	Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments
Investigators	James Falk (University of Delaware (UDEL)); Wendy Carey (University of Delaware (UDEL));
Partner	

Description	The goal of the proposed project entitled Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments is to integrate climate change adaptation's forward looking planning process with existing hazard mitigation actions of local governments. Given that coastal communities in the Mid-Atlantic currently face threats from natural hazards that may be exacerbated by climate change impacts creating a positive vision of resilience through the projects integrated hazard/climate change process will have regional and local salience. Delaware City, Delaware, is the specifically identified community partner for this project, but the initiative will also result in a step-wise training program and template that will be available to other communities to develop integrated hazard mitigation and climate change adaptation action plans. Materials will be developed in such a way that local governments can access them independently and adopt the information that is relevant to specific needs. Additionally, partner organizations and agencies can continue to provide these trainings and resources for other interested local governments. While hazard mitigation planning is a common effort and procedure undertaken by many communities, the present process is structured so that communities plan for future hazards based on current and historic risks. Climate change adaptation planning, with a longer term view of impacts and risks, focuses on understanding expected future impacts and the community's ability to address them. The integration of climate change into natural hazard mitigation planning is an important step in ensuring that local communities are prepared for today's hazards as well as future risks. By merging together traditional hazard mitigation planning concepts with climate adaptation planning concepts, local communities can be engaged in an intuitive and step-wise process. The outcome of this process is enhanced local knowledge of existing and future vulnerabilities – knowledge that is essential when making local decisions to increase resilience in areas such as infrastructural upgrades, zoning changes, ecosystem protection, and future development. The training program will be focused on developing and enhancing existing processes, incorporating existing tools, expanding local knowledge of climate change issues, and creating action oriented solutions to identified problems. The project involves a combined project partnership among Delaware Sea Grant, the Partnership for the Delaware Estuary (a National Estuary Program), The Resiliency Place (a business that specializes in providing long-term climate focused strategic planning to local governments), and the New Jersey Sea Grant Consortium which merges multiple levels of expertise and experience in hazard mitigation, climate change science, climate adaptation, and community engagement. The partners will work with Delaware City to enhance the preparedness planning process and create a locally applicable action plan that is responsive to changing conditions and impacts to community elements such as built infrastructure, environmental resources, and social/economic entities. Additionally, Pennsylvania Sea Grant will work in collaboration with the project partnership to extend community climate adaptation outreach efforts to local governments on a regional basis.
Progress	Management effort provided long-range planning, overall program direction, required reporting, and policy through quarterly and ad hoc meetings of the management staff. In support of the Omnibus proposal the DESG management team completed the Omnibus submission process. Two meetings were held (spring and fall) with the Delaware Sea Grant (DESG) management team and the Delaware Sea Grant Advisory Council (DE SGAC). Applications for both the

	Coastal Management and Dean John Knauss Marine Policy fellowships were solicited, reviewed, interviews completed, and final submissions made for both the Delaware applicants and three applicants from Washington, DC, in accordance with an agreement between the National Sea Grant Office, and the Virginia and Maryland Sea Grant Programs. Applications for funding under the National Sea Grant Office Aquaculture NSI were solicited, PI inquiries were addressed, and proposals were submitted to the National Office. Three members of the DESG Management Team participated in Sea Grant Week, 2012 to increase collaboration and communication across the Sea Grant Network. The 2014-2016 Request for Proposals (RFP) was developed from the content of the new strategic plan, with renewed attention to the outreach efforts associated with research based largely on a review of Sea Grant network 2012-2014 RFPs. Data management plan guidance was developed and included to reflect the new NOAA guidance and ensure the DESG 2014-2016 Omnibus will be in full compliance. The Management Team worked with six Sea Grant programs (NY, NJ, PA, MD, VA, NC) to establish the Mid-Atlantic Sea Grant Regional Research competition for the 2014-2016 Omnibus. The Management Team again secured FY2013 funding from the Delaware Legislature, with a slight increase over prior years to $564,000.
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Project Title	Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments
Investigators	James Falk (University of Delaware (UDEL)); Wendy Carey (University of Delaware (UDEL));
Partner	
Description	The goal of the proposed project entitled Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments is to integrate climate change adaptation's forward looking planning process with existing hazard mitigation actions of local governments. Given that coastal communities in the Mid-Atlantic currently face threats from natural hazards that may be exacerbated by climate change impacts creating a positive vision of resilience through the projects integrated hazard/climate change process will have regional and local salience. Delaware City, Delaware, is the specifically identified community partner for this project, but the initiative will also result in a step-wise training program and template that will be available to other communities to develop integrated hazard mitigation and

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Progress	Using Site Review Team input, strategic planning began in the fall of 2011 with Delaware Sea Grant Advisory Council discussions, followed by public surveys were distributed via the internet to identify public concerns about Delaware's coastal economy and ecosystems, and develop focus areas for strategic planning. A stakeholder workshop was held to review the survey input, foster discussion, and identify priorities for the 2014-2017 Strategic Plan. Upon release of the draft National Sea Grant Strategic Plan, the Delaware Sea Grant management team composed comments for consideration by the National Sea Grant Office, and incorporated appropriate alignments into the draft 2014-2017 Delaware Sea Grant Strategic Plan. The Delaware plan was submitted to the National Sea Grant Program and approved. The PRP process was completed, with submission of data to PIER and completion of a 20-page PRP Summary document, and submission of response comments upon receipt of the PRP final report.
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Investigators	James Falk (University of Delaware (UDEL)); Wendy Carey (University of Delaware (UDEL));
Partner	
Description	The goal of the proposed project entitled Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments is to integrate climate change adaptation's forward looking planning process with existing hazard mitigation actions of local governments. Given that coastal communities in the Mid-Atlantic currently face threats from natural hazards that may be exacerbated by climate change impacts creating a positive vision of resilience through the projects integrated hazard/climate change process will have regional and local salience. Delaware City, Delaware, is the specifically identified community partner for this project, but the initiative will also result in a step-wise training program and template that will be available to other communities to develop integrated hazard mitigation and climate change adaptation action plans. Materials will be developed in such a way that local governments can access them independently and adopt the information that is relevant to specific needs. Additionally, partner organizations and agencies can continue to provide these trainings and resources for other interested local governments. While hazard mitigation planning is a common effort and procedure undertaken by many communities, the present process is structured so that communities plan for future hazards based on current and historic risks. Climate change adaptation planning, with a longer term view of impacts and risks, focuses on understanding expected future impacts and the community's ability to address them. The integration of climate change into natural hazard mitigation planning is an important step in ensuring that local communities are prepared for today's hazards as well as future risks. By merging together traditional hazard mitigation planning concepts with climate adaptation planning concepts, local communities can be engaged in an intuitive and step-wise process. The outcome of this process is enhanced local knowledge of existing and future vulnerabilities – knowledge that is essential when making local decisions to increase resilience in areas such as infrastructural upgrades, zoning changes, ecosystem protection, and future development. The training program will be focused on developing and enhancing existing processes, incorporating existing tools, expanding local knowledge of climate change issues, and creating action oriented solutions to identified problems. The project involves a combined project partnership among Delaware Sea Grant, the Partnership for the Delaware Estuary (a National

	Estuary Program), The Resiliency Place (a business that specializes in providing long-term climate focused strategic planning to local governments), and the New Jersey Sea Grant Consortium which merges multiple levels of expertise and experience in hazard mitigation, climate change science, climate adaptation, and community engagement. The partners will work with Delaware City to enhance the preparedness planning process and create a locally applicable action plan that is responsive to changing conditions and impacts to community elements such as built infrastructure, environmental resources, and social/economic entities. Additionally, Pennsylvania Sea Grant will work in collaboration with the project partnership to extend community climate adaptation outreach efforts to local governments on a regional basis.
Progress	Delaware Sea Grant (DESG) was awarded NSGO Coastal Community Climate Adaptation funding to work with a community on preparing for climate change. DESG, the Partnership for the Delaware Estuary (a national estuary program) and The Resiliency Place (a climate change consulting group) are partnering with Delaware City, DE to enhance the preparedness planning process for today's hazards and future risks. The project's ultimate goal is to provide knowledge and guidance to the City as they chart a course for how to become resilient to natural hazards and climate change. As Delaware City continues its efforts to plan and prepare for natural hazards, a collaborative program is currently underway to improve community sustainability and resiliency. In collaboration with project partners and the City Manager, DESG worked to establish a Community Task Force to represent Delaware City and provide leadership throughout the project planning process. Through a series of four workshops, Sea Grant provided step-wise guidance as the community assessed vulnerabilities, reviewed best practices and actions implemented by other communities, and developed a list of priority strategies to meet specific needs of Delaware City with regard to hazard mitigation and climate adaptation. Throughout the Delaware City adaptation planning project, the intent is to work closely with a group of committed stakeholders and with the broader community to develop an action plan that will help to improve the City's economic, social and environmental well-being over time. DESG provided assistance to the community in establishing an Advisory Committee of subject-matter experts and practitioners who are willing to share their expertise and resources about collaborative opportunities and possible actions the City can take to reduce risk and vulnerabilities. Advisory Committee members are committed to provide assistance via leveraged expertise as adaptation actions are identified and implementation plans are developed. They have also agreed to support an on-going commitment with the community by maintaining communication with Delaware City with regard to opportunities for funding, coordination, and collaboration in the future.
Summary	

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	DE
Project Title	Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments
Investigators	James Falk (University of Delaware (UDEL)); Wendy Carey (University of Delaware (UDEL));
Partner	
Description	The goal of the proposed project entitled Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments is to integrate climate change adaptation's forward looking planning process with existing hazard mitigation actions of local governments. Given that coastal communities in the Mid-Atlantic currently face threats from natural hazards that may be exacerbated by climate change impacts creating a positive vision of resilience through the projects integrated hazard/climate change process will have regional and local salience. Delaware City, Delaware, is the specifically identified community partner for this project, but the initiative will also result in a step-wise training program and template that will be available to other communities to develop integrated hazard mitigation and climate change adaptation action plans. Materials will be developed in such a way that local governments can access them independently and adopt the information that is relevant to specific needs. Additionally, partner organizations and agencies can continue to provide these trainings and resources for other interested local governments. While hazard mitigation planning is a common effort and procedure undertaken by many communities, the present process is structured so that communities plan for future hazards based on current and historic risks. Climate change adaptation planning, with a longer term view of impacts and risks, focuses on understanding expected future impacts and the community's ability to address them. The integration of climate change into natural hazard mitigation planning is an important step in ensuring that local communities are prepared for today's hazards as well as future risks. By merging together traditional hazard mitigation planning concepts with climate adaptation planning concepts, local communities can be engaged in an intuitive and step-wise process. The outcome of this process is enhanced local knowledge of existing and future vulnerabilities – knowledge that is essential when making local decisions to increase resilience in areas such as infrastructural upgrades, zoning changes, ecosystem protection, and future development. The training program will be focused on developing and enhancing existing processes, incorporating existing tools, expanding local knowledge of climate change issues, and creating action oriented solutions to identified problems. The project involves a combined project partnership among Delaware Sea Grant, the Partnership for the Delaware Estuary (a National Estuary Program), The Resiliency Place (a business that specializes in providing long-term climate focused strategic planning to local governments), and the New Jersey Sea Grant Consortium which merges multiple levels of expertise and experience in hazard mitigation, climate change science, climate adaptation, and community engagement. The partners will work with Delaware City to enhance the preparedness planning process and create a locally applicable action plan

	that is responsive to changing conditions and impacts to community elements such as built infrastructure, environmental resources, and social/economic entities. Additionally, Pennsylvania Sea Grant will work in collaboration with the project partnership to extend community climate adaptation outreach efforts to local governments on a regional basis.
Progress	As Delaware City continues its efforts to plan and prepare for natural hazards, a collaborative program is currently underway to improve community sustainability and resiliency. Delaware Sea Grant, the Partnership for the Delaware Estuary and The Resiliency Place are partnering with Delaware City to enhance the preparedness planning process for today's hazards and future risks. The project's ultimate goal is to provide knowledge and guidance to the City as they chart a course for how to become resilient to natural hazards and climate change. Specific accomplishments related to the project include: preliminary meetings and discussions with the City Manager, and local planning committee that was established for the project; multiple conference calls with project partners to plan and organize project approach, suggestions for task force and steering committee members, and workshop topics, agendas, schedule; background research on Delaware City and information collection and synthesis on topics such as flood mitigation planning, hazard mitigation planning, building codes, emergency management, etc. – e.g. review of Delaware City Comprehensive Plan, Hazard Mitigation Plan, and Flood Mitigation Plan. A synthesis / compilation of information related to potential risks and vulnerabilities from natural hazards and climate change impacts to Delaware City has been conducted, and relevant information has been documented and compiled for fact sheets and a final report.
Summary	

Program	DE
Project Title	Weathering Change - Integrated Hazard and Adaptation Training to Create Resilient Local Governments
Investigators	James Falk (University of Delaware (UDEL)); Wendy Carey (University of Delaware (UDEL));
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Progress	In collaboration with project partners and the City Manager, Delaware Sea Grant worked to establish a Community Task Force to represent Delaware City and provide leadership throughout the project planning process. Through a series of four workshops, Sea Grant provided step-wise guidance as the community assessed vulnerabilities, reviewed best practices and actions implemented by other communities, and developed a list of priority strategies to meet specific needs of Delaware City with regard to hazard mitigation and climate adaptation.
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Progress	Throughout the Delaware City adaptation planning project, the intent is to work closely with a group of committed stakeholders and with the broader community to develop an action plan that will help to improve the City's economic, social and environmental well-being over time. Delaware Sea Grant provided assistance to the community in establishing an Advisory Committee of subject-matter experts and practitioners who are willing to share their expertise and resources about collaborative opportunities and possible actions the City can take to reduce risk and vulnerabilities. Advisory Committee members are committed to provide assistance via leveraged expertise as adaptation actions are identified and implementation plans are developed. They have also agreed to support an on-going commitment with the community by maintaining communication with Delaware City with regard to opportunities for funding, coordination, and collaboration in the future.
Summary	

Program	DE
Project Title	Quantifying Spatio-Temporal Variability in Hydrodynamics and Inundation of a Tidal Saltmarsh (Brockonbridge Marsh, Ken County, Delaware)
Investigators	Jack A. Puleo (University of Delaware (UDEL)); Thomas E. McKenna (University of Delaware (UDEL));
Partner	Delaware Geological Survey; Delaware Wildlands, LLC; ; US Geological Survey (US DOI, USGS);
Description	The objective of this study is to evaluate the efficacy of coupling image-based remote sensing and in-situ measurements to quantify fundamental hydrologic parameters required for understanding and modeling shallow water flow in tidal wetlands. Goals: 1) To finalize development of an innovative ground-based multi-spectral imaging system (visible [RGB]

	and near/thermal infrared [NIR/TIR]) to investigate hydrologic processes at timescales (subsecond to minutes) commensurate with intertidal processes (minutes/hours). 2) To quantify spatio-temporal patterns of inundation, surficial flow velocity, bed stress, and turbulent energy dissipation as function of tidal height, tidal phase and proximity to channels. 3) To develop correlations/predictions of sediment suspension and transport from measured and calculated hydrologic parameters. Findings: 1) Eustatic sea level is expected to increase 0.18 to 0.59 m over the next century [IPCC, 2007]. 2) Relative sea-level rise in the study area is currently the highest along the Atlantic coast of the U.S., about two times higher than the current eustatic rate. 3) Increasing rates of sea level rise result in conversion of tidal wetlands to intertidal flats if sedimentation and land subsidence rates remain constant. 4) Erosion can accelerate when wetlands are converted to intertidal flats. Erosion can impact water quality by releasing large quantities of sequestered carbon, nutrients and anthropogenic pollutants. 5) Biological productivity in tidal wetlands is much higher than in intertidal flat environments. 6) The Delaware Estuary has more than 150,000 hectares of wetlands that have degraded significantly since 1984. 7) Capabilities of hydrodynamic models that include wetting/drying of tidal wetlands have outpaced the collection of data needed to constrain the models. 8) To our knowledge, this is the first field study to investigate variability of hydrologic processes in tidal wetlands at the high temporal and spatial resolution obtainable with a ground-based imaging system (submeter to meter; subsecond to minutes). Need: Improved predictive models are required if scientists and engineers are to understand and potentially mitigate the negative effects on marshes exacerbated by rising sea levels. This study contributes to understanding of fundamental hydrologic and sediment transport processes required to improve existing models. Action: Perform an extensive field study to investigate a) the spatio-temporal variability in surficial velocities, b) the highly-resolved, nearbed velocity profile that can be used to quantify hydrodynamic stresses and turbulent kinetic energy dissipation in the shallow flow regime of a tidal wetland, c) suspended sediment variability and d) wetland inundation at a high spatiotemporal resolution over a spring tidal cycle.
Progress	Management effort provided long-range planning, overall program direction, required reporting, and policy through quarterly and ad hoc meetings of the management staff. In support of the Omnibus proposal the DESG management team completed the Omnibus submission process. Two meetings were held (spring and fall) with the Delaware Sea Grant (DESG) management team and the Delaware Sea Grant Advisory Council (DE SGAC). Applications for both the Coastal Management and Dean John Knauss Marine Policy fellowships were solicited, reviewed, interviews completed, and final submissions made for both the Delaware applicants and three applicants from Washington, DC, in accordance with an agreement between the National Sea Grant Office, and the Virginia and Maryland Sea Grant Programs. Applications for funding under the National Sea Grant Office Aquaculture NSI were solicited, PI inquiries were addressed, and proposals were submitted to the National Office. Three members of the DESG Management Team participated in Sea Grant Week, 2012 to increase collaboration and communication across the Sea Grant Network. The 2014-2016 Request for Proposals (RFP) was developed from the content of the new strategic plan, with renewed attention to the outreach efforts associated with research based largely on a review of Sea Grant network 2012-2014 RFPs. Data management plan guidance was developed and included to reflect the new NOAA guidance and ensure the

	DESG 2014-2016 Omnibus will be in full compliance. The Management Team worked with six Sea Grant programs (NY, NJ, PA, MD, VA, NC) to establish the Mid-Atlantic Sea Grant Regional Research competition for the 2014-2016 Omnibus. The Management Team again secured FY2013 funding from the Delaware Legislature, with a slight increase over prior years to $564,000.
Summary	

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Partner	Delaware Geological Survey; Delaware Wildlands, LLC; ; US Geological Survey (US DOI, USGS);
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	variability of hydrologic processes in tidal wetlands at the high temporal and spatial resolution obtainable with a ground-based imaging system (submeter to meter; subsecond to minutes). Need: Improved predictive models are required if scientists and engineers are to understand and potentially mitigate the negative effects on marshes exacerbated by rising sea levels. This study contributes to understanding of fundamental hydrologic and sediment transport processes required to improve existing models. Action: Perform an extensive field study to investigate a) the spatio-temporal variability in surficial velocities, b) the highly-resolved, nearbed velocity profile that can be used to quantify hydrodynamic stresses and turbulent kinetic energy dissipation in the shallow flow regime of a tidal wetland, c) suspended sediment variability and d) wetland inundation at a high spatiotemporal resolution over a spring tidal cycle.
Progress	Using Site Review Team input, strategic planning began in the fall of 2011 with Delaware Sea Grant Advisory Council discussions, followed by public surveys were distributed via the internet to identify public concerns about Delaware's coastal economy and ecosystems, and develop focus areas for strategic planning. A stakeholder workshop was held to review the survey input, foster discussion, and identify priorities for the 2014-2017 Strategic Plan. Upon release of the draft National Sea Grant Strategic Plan, the Delaware Sea Grant management team composed comments for consideration by the National Sea Grant Office, and incorporated appropriate alignments into the draft 2014-2017 Delaware Sea Grant Strategic Plan. The Delaware plan was submitted to the National Sea Grant Program and approved. The PRP process was completed, with submission of data to PIER and completion of a 20-page PRP Summary document, and submission of response comments upon receipt of the PRP final report.
Summary	

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Progress	Funding was provided to support 5 M.S. students and 6 Ph.D. students in conjunction with DESG research projects. PIs managed the projects and the students, while the funding for the students was handled by the DESG office through a line item of the Omnibus proposal. Overall funding was supplied for a total of 8.5 FTE.
Summary	

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Progress	The hydrodynamic model for tidal inundation, sedimentation, and evolution in tidal salt marshes has been implemented. Model verification awaits data to be collected during spring and summer 2013, and work on sedimentation processes is underway. Specifically, the tidal hydrodynamics component of the model has been implemented using the model NearCoM (developed at University of Delaware) and is being applied to a study of tidal circulation in Brockonbridge Gut, Kent County, DE. A sampling schedule and protocol is underway for March 2013, in partnership with additional Sea Grant-funded research groups (HRCC-1), to collect hydrologic data for model

	parameterization and later validation. Data gathered from Brockonbridge Gut marsh will be used in conjunction with USGS stream gauge data to ensure the mathematical effort provides appropriate representation of the real system. The primary data collection program will be between March 17 and April 3, 2013. An additional tide gage will be maintained at a bridge crossing the marsh at an upstream location, and return trips will be made to conduct bottom surveying during summer 2013.
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Progress	Delaware Sea Grant Researchers have designed and constructed a portable remote sensing platform, designed field experiments, prepared for and performed the complex and extensive field experiment to improve fine-scale measurements of tidal marsh hydrology and elevation. Data collected includes imagery, in situ elevation data, water and sediment quality and quantity measurements, all associated with fine-scale GPS coordinates. Public presentations and demonstrations of the technology were completed, with audiences that included resource managers, environmental consultants, graduate and undergraduate students. A comprehensive planning document and safety plan was developed that guided preparation and field work. The field effort was coordinated with complementary Sea Grant-funded work (HRCC-2). The site was visited on 4 different occasions. Preliminary imagery, surveying procedures, boat access, pumps for water/sediment samples, and deployment platforms on the soft mud flat sediment were secured or completed. The deployment platforms are aluminum tripods procured on a prior Delaware Sea Grant funded project (NOAA SG0910 RETE14 PULEO). A data logger power and control enclosure for simultaneous logging of over 40 in situ sensors and an apparatus for topographic surveying on soft mud was designed, fabricated and tested. The survey sled contains a GPS receiver and is pulled back and forth across the flat when it is exposed to record the surface elevation. Work was coordinated with the Delaware Wildlands program manager and members of the South Bowers Sportsmen's Cub who provided access to the field site and lodging. Volunteers were recruited to help with the field effort. Field work was successfully completed over 25 days in March and April 2013 with over 16 days of imagery collected on 1-minute intervals and in-situ data collected at a higher frequency. Data collection relied on a customized telescoping tower, installed on a heavy duty trailer, which relies on a winch and outriggers for deployment and stabilization in the field. Participants lived in lodging at the site during the experiment. The two PIs and graduate student were each on site for over 20 days along with a rotating team of 13 graduate and 6 undergraduate students who worked in shifts around the clock during the experiment; over 2,100 man hours were contributed, equivalent to one man year at 8 hrs per day for 5 days a week! A presentation entitled "Observing the Land-Sea Interface: New Technology for Addressing Sea Level Issues") was made to approximately 100 people at the Delaware Geologic Research Symposium on April 16, 2013 in Newark, Delaware. The audience primarily consisted of natural resource managers and environmental consultants. Over30 of the attendees visited an associated open house event at the Delaware Geological

	Survey where the portable tower and a thermal imager were displayed.
Summary	

Program	DE
Project Title	A Process-Based Model of Long Term Marsh Platform and Shoreline Evolution in Response to Rising Sea Level and Changing Sediment Supplies
Investigators	Fengyan Shi (University of Delaware (UDEL)); James T. Kirby (University of Delaware (UDEL));
Partner	Delaware Geological Survey; Delaware Wildlands, LLC; ; US Geological Survey (US DOI, USGS);
Description	We propose to continue the development of a predictive model for long term marsh evolution in a complex multi-component coastal environment consisting of coastal plane estuaries and adjacent coastal lagoon systems, as begun in our present one-year Sea Grant project. Our initial modeling effort is concentrated on Delaware Bay and it's fringing environments, characterized by coastal topography of low relief and a moderate, semidiurnally dominant tidal environment. Delaware Bay is fringed by extensive salt marsh environments, which are present in a range of natural to heavily altered states. The ongoing year one of this effort is concentrated on the extension of an existing onedimensional model for salt marsh platform and marsh edge evolution, in order to examine effects associated with groundwater percolation and the resulting development of unsaturated zones, which are hypothesized elsewhere to have a strong influence on the distribution of plant species. We will utilize this model to study marsh shoreline erosion in the Delaware Inland Bay system, using historical records of wind and tidal conditions. We will implement a new version of the structured grid model NearCoM, with a morphology module extended to include marsh sedimentation and a vegetation model, and apply it to a protected marsh (Brockonbridge Gut, along Delaware Bay) and to a fringing marsh in Rehoboth Bay, part of the Delaware Inland Bay. Finally, we will take part in a field study of tidal inundation (Puleo and McKenna) in the Brockonbridge marsh in order to obtain data for model verification and to assist in determining the overall water budget for the system in support of the experiment.
Progress	Management effort provided long-range planning, overall program direction, required reporting, and policy through quarterly and ad hoc meetings of the management staff. In support of the Omnibus proposal the DESG management team completed the Omnibus submission process. Two meetings were held (spring and fall) with the Delaware Sea Grant (DESG) management team and the Delaware Sea Grant Advisory Council (DE SGAC). Applications for both the

| | Coastal Management and Dean John Knauss Marine Policy fellowships were solicited, reviewed, interviews completed, and final submissions made for both the Delaware applicants and three applicants from Washington, DC, in accordance with an agreement between the National Sea Grant Office, and the Virginia and Maryland Sea Grant Programs. Applications for funding under the National Sea Grant Office Aquaculture NSI were solicited, PI inquiries were addressed, and proposals were submitted to the National Office. Three members of the DESG Management Team participated in Sea Grant Week, 2012 to increase collaboration and communication across the Sea Grant Network. The 2014-2016 Request for Proposals (RFP) was developed from the content of the new strategic plan, with renewed attention to the outreach efforts associated with research based largely on a review of Sea Grant network 2012-2014 RFPs. Data management plan guidance was developed and included to reflect the new NOAA guidance and ensure the DESG 2014-2016 Omnibus will be in full compliance. The Management Team worked with six Sea Grant programs (NY, NJ, PA, MD, VA, NC) to establish the Mid-Atlantic Sea Grant Regional Research competition for the 2014-2016 Omnibus. The Management Team again secured FY2013 funding from the Delaware Legislature, with a slight increase over prior years to $564,000. |
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Progress	Using Site Review Team input, strategic planning began in the fall of 2011 with Delaware Sea Grant Advisory Council discussions, followed by public surveys were distributed via the internet to identify public concerns about Delaware's coastal economy and ecosystems, and develop focus areas for strategic planning. A stakeholder workshop was held to review the survey input, foster discussion, and identify priorities for the 2014-2017 Strategic Plan. Upon release of the draft National Sea Grant Strategic Plan, the Delaware Sea Grant management team composed comments for consideration by the National Sea Grant Office, and incorporated appropriate alignments into the draft 2014-2017 Delaware Sea Grant Strategic Plan. The Delaware plan was submitted to the National Sea Grant Program and approved. The PRP process was completed, with submission of data to PIER and completion of a 20-page PRP Summary document, and submission of response comments upon receipt of the PRP final report.
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Progress	Funding was provided to support 5 M.S. students and 6 Ph.D. students in conjunction with DESG research projects. PIs managed the projects and the students, while the funding for the students was handled by the DESG office through a line item of the Omnibus proposal. Overall funding was supplied for a total of 8.5 FTE.
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Progress	The hydrodynamic model for tidal inundation, sedimentation, and evolution in tidal salt marshes has been implemented. Model verification awaits data to be collected during spring and summer 2013, and work on sedimentation processes is underway. Specifically, the tidal hydrodynamics component of the model has been implemented using the model NearCoM (developed at University of Delaware) and is being applied to a study of tidal circulation in Brockonbridge Gut, Kent County, DE. A sampling schedule and protocol is underway for March 2013, in partnership with additional Sea Grant-funded research groups (HRCC-1), to collect hydrologic data for model parameterization and later validation. Data gathered from Brockonbridge Gut marsh will be used in conjunction with USGS stream gauge data to ensure the mathematical effort provides appropriate representation of the real system. The primary data collection program will be between March 17 and April 3, 2013. An additional tide gage will be maintained at a bridge crossing the marsh at an upstream location, and return trips will be made to conduct bottom surveying during summer 2013.
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Progress	Delaware Sea Grant Researchers have designed and constructed a portable remote sensing platform, designed field experiments, prepared for and performed the complex and extensive field experiment to improve fine-scale measurements of tidal marsh hydrology and elevation. Data collected includes imagery, in situ elevation data, water and sediment quality and quantity measurements, all associated with fine-scale GPS coordinates. Public presentations and demonstrations of the technology were completed, with audiences that included resource managers, environmental consultants, graduate and undergraduate students. A comprehensive planning document and safety plan was developed that guided preparation and field work. The field effort was coordinated with complementary Sea Grant-funded work (HRCC-2). The site was visited on 4 different occasions. Preliminary imagery, surveying procedures, boat access, pumps for water/sediment samples, and deployment platforms on the soft mud flat sediment were secured or completed. The deployment platforms are aluminum tripods procured on a prior Delaware Sea Grant funded project (NOAA SG0910 RETE14 PULEO). A data logger power and control enclosure for simultaneous logging of over 40 in situ sensors and an apparatus for topographic surveying on soft mud was designed, fabricated and tested. The survey sled contains a GPS receiver and is pulled back and forth across the flat when it is exposed to record the surface elevation. Work was coordinated with the Delaware Wildlands program manager and members of the South Bowers Sportsmen's Cub who provided access to the field site and lodging. Volunteers were recruited to help with the field effort. Field work was successfully completed over 25 days in March and April 2013 with over 16 days of imagery collected on 1-minute intervals and in-situ data collected at a higher frequency. Data collection relied on a customized telescoping tower, installed on a heavy duty trailer, which relies on a winch and outriggers for deployment and

	stabilization in the field. Participants lived in lodging at the site during the experiment. The two PIs and graduate student were each on site for over 20 days along with a rotating team of 13 graduate and 6 undergraduate students who worked in shifts around the clock during the experiment; over 2,100 man hours were contributed, equivalent to one man year at 8 hrs per day for 5 days a week! A presentation entitled "Observing the Land-Sea Interface: New Technology for Addressing Sea Level Issues") was made to approximately 100 people at the Delaware Geologic Research Symposium on April 16, 2013 in Newark, Delaware. The audience primarily consisted of natural resource managers and environmental consultants. Over30 of the attendees visited an associated open house event at the Delaware Geological Survey where the portable tower and a thermal imager were displayed.
Summary	

Program	DE
Project Title	Synoptic descriptions of low-level winds and surface currents outside the Delaware Bay mouth for use in ecosystem studies and hazard response planning
Investigators	Bruce Lipphardt (University of Delaware (UDEL)); Dana Veron (University of Delaware (UDEL));
Partner	
Description	The objective of this project is a two-pronged approach of data mining and regional atmospheric and oceanic modeling to characterize in far greater detail than previously the current state of the Delaware Bay region. This will be done using a suite of meteorological instruments and radars located near and along coastal New Jersey and Delaware. A climatology of the surface winds and currents developed from observations for southern coastal Delaware (Hughes 2011, Hughes and Veron 2012), will be extended to cover the entire Delaware Bay and nearby ocean coasts. Highresolution atmospheric model runs will be performed for the same time period (2009-2011). Significant improvements to the surface input of the model will be made including modification of the land surface to match current land use change maps and input of high-resolution satellite-based sea surface temperatures. The model-predicted surface winds will be evaluated using data from the Delaware Environmental Observing System, the Rutgers Weather Network, National Data Buoy Center as well as local CODARs measuring surface currents following Muscarella et al. (2011). The variability of the local winds, in particular the sea breeze, will be assessed by standard meteorological observations, modeling and through analysis of weather radar and CODAR. Understanding this variability will greatly

	improve our ability to assess the impact of changes to this environment through climate change, human-driven coastal urbanization, or man-made or natural disasters. As the population continues to grow, the coastline develops and urbanizes, and the demand and use of coastal resources increases. For example, not only are the local beaches and water ways, such as the Delaware Bay and the New Jersey, Delaware and Maryland ocean fronts, used more frequently for recreation, there is also an increased demand for utilities such as electricity and infrastructure. In preparing for the greater demands on our coastal environment, we feel it is important to have a complete understanding of the current state of the environment, which includes, but is not limited to, the low-level winds and surface currents. Thorough knowledge of the background state then allows assessment of changes, manmade or otherwise, and the impact of these changes. For example, understanding of the currents and winds can help with search and rescue activities, modeling of aerosol transport, coastal flood prediction, predicting and assessing storm impacts, and preparation of offshore renewal energy sources such as offshore wind turbines or ocean turbines. This project will extend analysis begun in prior work in order to develop a deeper understanding of the surface meteorology and oceanography of the Delaware Bay and nearby coastlines.
Progress	Management effort provided long-range planning, overall program direction, required reporting, and policy through quarterly and ad hoc meetings of the management staff. In support of the Omnibus proposal the DESG management team completed the Omnibus submission process. Two meetings were held (spring and fall) with the Delaware Sea Grant (DESG) management team and the Delaware Sea Grant Advisory Council (DE SGAC). Applications for both the Coastal Management and Dean John Knauss Marine Policy fellowships were solicited, reviewed, interviews completed, and final submissions made for both the Delaware applicants and three applicants from Washington, DC, in accordance with an agreement between the National Sea Grant Office, and the Virginia and Maryland Sea Grant Programs. Applications for funding under the National Sea Grant Office Aquaculture NSI were solicited, PI inquiries were addressed, and proposals were submitted to the National Office. Three members of the DESG Management Team participated in Sea Grant Week, 2012 to increase collaboration and communication across the Sea Grant Network. The 2014-2016 Request for Proposals (RFP) was developed from the content of the new strategic plan, with renewed attention to the outreach efforts associated with research based largely on a review of Sea Grant network 2012-2014 RFPs. Data management plan guidance was developed and included to reflect the new NOAA guidance and ensure the DESG 2014-2016 Omnibus will be in full compliance. The Management Team worked with six Sea Grant programs (NY, NJ, PA, MD, VA, NC) to establish the Mid-Atlantic Sea Grant Regional Research competition for the 2014-2016 Omnibus. The Management Team again secured FY2013 funding from the Delaware Legislature, with a slight increase over prior years to $564,000.
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	nearby coastlines.
Progress	Using Site Review Team input, strategic planning began in the fall of 2011 with Delaware Sea Grant Advisory Council discussions, followed by public surveys were distributed via the internet to identify public concerns about Delaware's coastal economy and ecosystems, and develop focus areas for strategic planning. A stakeholder workshop was held to review the survey input, foster discussion, and identify priorities for the 2014-2017 Strategic Plan. Upon release of the draft National Sea Grant Strategic Plan, the Delaware Sea Grant management team composed comments for consideration by the National Sea Grant Office, and incorporated appropriate alignments into the draft 2014-2017 Delaware Sea Grant Strategic Plan. The Delaware plan was submitted to the National Sea Grant Program and approved. The PRP process was completed, with submission of data to PIER and completion of a 20-page PRP Summary document, and submission of response comments upon receipt of the PRP final report.
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Progress	Progress using NEXRad and Delaware Environmental Observing System data has improved the characterization of the details of sea breeze circulation. Detailed analysis of the coincidence of upwelling and sea breeze circulation using 5 years of meteorological, oceanographic, weather radar and satellite sea surface temperature data. Several hundred cases from 2007-2012 were examined and three atmospheric states were analyzed: classic sea breeze, breezes which move up the bay, and no sea breeze. Using synoptic typing, reanalysis data, and satellite sea surface temperature data, it is evident that upwelling at the mouth of the bay plays an important role in determining the occurrence as well as some of the details of the local winds. Two dominant types of local breezes were characterized using weather radar located in Dover – sea breeze and bay breeze. The research has identified the atmospheric state during which sea breeze is most likely to dominate the local wind circulation. The graduate student funded in support of the project will complete his degree in the Spring of 2013. Presentations of the work and were included in the College of Earth, Ocean, and Environment's Physical Ocean Science and Engineering seminar in October, 2012, the Lamont Doherty Earth Observatory seminar series, at Coast Day, at a lecture for the Tatnall School's environmental science students, and at the Atlantic Wind Consortium meeting. Data from this project was used in lectures for the TIDE camp as well as for an undergraduate research project. With Delaware Marine Advisory Service Assistance a lesson plan was developed. It is aligned to state science standards for grades 6-12, and freely available at: http://www.deseagrant.org/education/resources/SeabreezeActivity.
Summary	

Program	FL
Project Title	Building Local Capacity: Workshops on Legal Issues in Sea-Level Rise Adaptation for Local Governments in Florida and Providing Adaptation Assistance to Local Governments
Investigators	Ruppert, Thomas (University of Florida (UF));
Partner	
Description	OBJECTIVES: Increase the level of knowledge that local government planners, attorneys, and decision makers possess about the science of sea-level rise (SLR), the likely impacts of SLR, and options available to local governments to address SLR. METHODOLOGY: Year 1 will focus primarily on implementation of 3 or 4 full-day workshops that focus on legal issues that are important for local governments to consider when evaluating potential adaptation strategies for SLR. Year 2 will focus mostly on one of two options. The first option is development of a paper, with case studies, of "strategic relocation" as a way in which Floridians have in the past sometimes addressed coastal hazards. The second option is development of a module on coastal planning and SLR to introduce newly-elected local government officials to the basics of good coastal planning, hazard mitigation, and SLR planning/adaptation. During both years a portion of the time supported by these funds will be dedicated to allowing Florida Sea Grant and Mr. Ruppert to respond to inquiries or requests for SLR information, presentations, and technical assistance. RATIONALE: The State of Florida has not demonstrated leadership in adaptation to one of the most important aspects of climate change for the state: SLR. Until recently, SLR was not even mentioned in Florida statutes and only appeared once in the several volumes of Florida's administrative code. Despite this, a few local governments continue to forge ahead. A group of pioneering local governments developed the Southeast Climate Compact (SECC), representing four counties comprising 1/3 of Florida's population. The SECC has requested that Florida Sea Grant present the workshop "Adaptive Planning for Sea-Level Rise: Legal Issues for Local Government" in southeast Florida, but the SECC has no funds to support this. Year one will allow Florida Sea Grant and Thomas Ruppert to accomplish this. The funds will also allow Mr. Ruppert to respond to requests from local governments for information on SLR and SLR adaptation.
Progress	Florida is one of the most at-risk locations in the U.S. for sea-level rise impacts, due to its low topography, and the concentration of more than 80 percent of its population in the coastal zone. While some major cities have begun planning for sea-level-rise, most coastal locations are ill- prepared for it. Nonetheless, many are already experiencing negative impacts, both in the built and natural environments. Florida Sea Grant is applying innovative approaches to develop policies that address issues of hazard resilience. Examples include hurricane and risk assessment workshops that educate coastal residents in Pinellas, Franklin, Lee, Wakulla, Monroe and Sarasota counties about evacuation zones,

	hurricane planning, and how to secure property and possessions. Furthermore, Florida Sea Grant's Coastal Planning Specialist conducted a series of sea-level-rise adaptation planning forums in Wakulla, Collier, and Sarasota counties that applied a new mapping and visualization technology called CommunityViz to facilitate public engagement and community decision-making about identifying hazards and planning for sea-level-rise. In 2012, 3,644 coastal residents, 168 resource managers and 97 local government officials participated in Florida Sea Grant hazard resilience programming.
Summary	Florida Sea Grant outreach applies new technologies to help coastal residents and communities increase hazard resiliency.

Program	FL
Project Title	Planning for Sea Level Rise
Investigators	Ruppert, Thomas (University of Florida (UF));
Partner	
Description	OBJECTIVES: A Evaluate and Improve the Development and Delivery of Habitat Vulnerability Assessments and Adaptive Conservation Designs. METHODOLOGY: This project will directly address the Florida Sea Grant priority to: "Develop and test innovative processes and/or tools for communities to make informed decisions regarding adaptations to sea level rise." The project will conduct action research in Levy County and the larger Big Bend region along the Gulf Coast of Florida. The Big Bend region is a unique, ecologically valuable expanse of tidal marshes among numerous estuaries spanning from Tarpon Springs near St. Petersburg to Panacea just east of St. George Island. More detailed modeling of the St. Marks National Wildlife Preserve confirmed that "major portions of [the Big Bend] coastal zone will be permanently inundated by 2100, bringing about a combined migration of marsh habitat and displacement of forest habitat" (Doyle et al. 2003, p. 201). These dramatic results occurred under International Panel on Climate Change (IPCC) 1996 sea level rise scenarios, and the Panel has since revised these levels upward. RATIONALE: Climate change is one of the most serious threats to global sustainability, and the accompanying sea level rise will significantly impact low-lying coastal areas, including along the Florida Panhandle and Peninsula (Deyle et al. 2007; Florida ceans and Coastal Council 2010). Rural coastal areas are uniquely vulnerable to sea level rise, because they have limited resources with which to plan and adapt to this threat. See Figure 2 for a map of rural counties and regions in Florida. At the same time, rural

	areas have important social, cultural, economic, and ecological assets that are deserving of quality, proactive planning (Stauber 2001, Woods 2005, Agrawal 2008). The interactions of the linked social and ecological system are especially apparent in rural areas, yet sea level rise adaptation planning often does not plan at a scale adequate to account for these interactions, or addresses only one sub-system (such as agriculture or habitat/ecosystem). Given that sea level rise will impact coastal communities, habitats, and working lands, and there may be conflict between these interests, it is critical that planners take an integrated approach.
Progress	
Summary	

Program	FL
Project Title	An Intergrated Climate Change Impact Assessment Tool for Flooding of the Lower St. Johns River
Investigators	Dingbao Wang (University of Central Florida (UCF)); Kaveh Madani (University of Central Florida (UCF)); Peter Bacopoulos (University of Central Florida (UCF));
Partner	
Description	OBJECTIVES: To produce an innovative modeling approach for assessing climate change impacts on urban flooding as applicable to coastal areas in Florida. Specific objectives: 1) To Develop an integrated hydrologic and hydrodynamic modeling tool for assessing the impacts of extreme rainfall change and sea level rise (SLR); 2) To model the effects of overland flow, groundwater discharge, astronomic tides, and SLR on flooding; 3) To project future rainfall intensity-duration-frequency (IDF) curves; 4) To estimate the economic costs flooding and benefits of alternative climate change adaptation strategies. METHODOLOGY: A rainfall-runoff component (curve number method) is implemented in the ADCIRC-2DDI model, and is calibrated for Tropical Storm Fay (T.S. Fay), based on which an economic costs assessment model is developed. The integrated model is applied to assess flood inundation under scenarios of updated IDF curves (downscaling of regional climate model outputs), SLR, and potential land use change. The developed economic assessment model is applied to assess the costs of future climatic changes and benefits of adaptation strategies for flood control. RATIONALE: Climate change is likely to impact coastal regions with increased heavy rainfall and SLR especially in flat and low-lying areas (like Florida). To mitigate the impact of these effects on the urban flooding, an

	integrated climate change impact assessment tool needs to be developed to make informed decisions regarding adaptation strategies for flooding. The end users are Florida Silver Jackets which include USACE, FEMA, NOAA, National Weather Service, USGS, St. Johns Water Management District, State Emergency Response Team, Florida Department of Transportation and others. IMPACTS: 1) Providing a geospatial information tool useful to coastal resource managers for assessing different adaptation strategies to climate change impact on floods; 2) Modified IDF curves for local engineering design and current facility retrofit such as storm water drainage systems; 3) The assessment of groundwater contribution to the streamflow benefits understanding stream ecosystem and water quality studies.
Progress	
Summary	

Program	GA
Project Title	Tybee Island, GA – Developing a 50-year Climate Adaptation Plan for a Highly Vulnerable Barrier Island Community
Investigators	Charles Hopkinson (Georgia Sea Grant); David Bryant (Georgia Sea Grant); Jason Evans (Carl Vison Institute of Government (UGA)); Rob McDowell (Carl Vison Institute of Government (UGA));
Partner	Carl Vison Institute of Government (UGA); Chatham County Chatham County - Savannah Metropolitan Planning Commission; Coastal Regional Development Agency ; Georgia Department of Natural Resources, Coastal Resources Division (GA DNR, CRD); Georgia Departmen
Description	This project is a partnership between the City of Tybee Island, the University of Georgia, Georgia Sea Grant, and the Coastal Resources Division of the Georgia Department of Natural Resources (CRD) to develop a detailed climate adaptation plan for the barrier island community of Tybee Island, Georgia. The plan will be developed through a series of community workshops facilitated through the Vulnerability Consequences Adaptation Planning Scenarios (VCAPS) process. Detailed cost-benefit analyses of future vulnerabilities and specific adaptation scenarios will be performed through with the Coastal Adaptation to Sea level rise Tool (COAST), an advanced GIS package that models and visualizes specific sectoral impacts from storm surges and coastal flooding. Results from the VCAPS discussion and COAST scenarios will be used as a foundation for prioritizing, developing timescales, and initiating municipal finance planning for the development of the adaptation action plan. The City of Tybee Island has formally agreed to consider adopting the recommendations developed by this project through appropriate local ordinances, infrastructural improvements,

	and other municipal actions, with Georgia Sea Grant, CRD, the University of Georgia, and other state agencies providing outreach and extension support through this implementation phase. It is expected that this project will serve as a model for advanced adaptation planning and implementation for other coastal communities of Georgia, the southeast region, and across the nation.
Progress	In May 2012, the project team, led by Jason Evans of the UGA's Carl Vinson Institute of Government and Chuck Hopkinson of Georgia Sea Grant, convened an introductory public meeting at the Tybee Island City Hall. The meeting introduced the proposed planning process to the mayor, city staff, the city council, the Savannah-Chatham Metropolitan Planning Commission and members of the general public. In August, the process began in earnest with another public meeting that identified potential problems, prioritized adaptation options and chose SLR scenarios for which to plan. At both meetings, public and institutional representatives were very engaged and considerable media coverage was generated: http://www.redandblack.com/news/uga-georgia-sea-grant-help-tybee-island-prepare-for-climate/article_352f0976-96dd-56d9-81c3-e6d8ceebd33d.html http://savannahnow.com/news/2012-08-06/tybee-island-hosting-workshops-prepare-rising-sea-levels http://savannahnow.com/news/2012-05-08/tybee-planning-rising-sea-levels http://www.wtoc.com/story/18345283/grant-to-help-tybee-island-with-climate-change?clienttype=printable http://www.csc.noaa.gov/digitalcoast/stories/tybee http://www.gpb.org/news/2012/08/07/tybee-addresses-rising-sea-levels http://www.wtoc.com/story/21447607/tybee-residents-to-discuss-flood-prep-due-to-rising-sea-levels
Summary	

Program	GA
Project Title	Program Development
Investigators	Charles Hopkinson (Georgia Sea Grant); David Bryant (Georgia Sea Grant);
Partner	
Description	(22) Objectives : 1. To initiate new projects that implement the Georgia Sea Grant College Program's Strategic Plan during 2012 – 2014 2. To fund Program Development grants that address emerging issues, at regional, national or international levels 3.To fund rapid response projects, which meet immediate, needs or uniqueopportunities identified by clientele groups, agencies,researchers, or outreach personnel 4. To facilitate participation in program planning

	activities national, regional and international NOAA & Sea Grant program initiatives (23) Methodology : Program Development supports projects in two categories that are important to the National Sea Grant College Program concept. The first category contains the Program Development grants that support emerging research directions with potential significance to Sea Grant College Program goals and objectives. These projects often need preliminary investigations before they mature as Sea Grant projects, or they emerge between the program biennial requests for proposals. Funding levels for Program Development (PD) grants are usually less than $10,000. PD projects that exceed $15,000 undergo a review process that is no less stringent than for projects in the omnibus proposal. The written peer review process is the same as regular competitive projects and the projects often emerge from the competitive review process. The projects also must be approved by the NSGO program officer before they are implemented. PD projects may then be resubmitted in the next two-year funding cycle. At that point the project scope expands and funding increases or it terminates if the research directions are judged unproductive. The Georgia Sea Grant College Program developed a strategic plan on a parallel track with Sea Grant's National Strategic Plan for 2010-2013. While the strategic plan will guide the Georgia Sea Grant College Program proposal development process, issues emerge almost overnight and Sea Grant must be poised to respond to them. One emerging issue that may demand program development funds is related to groundwater and surface water extraction and its impact on the estuarine environment. Estuaries are created by freshwater; as freshwater input diminishes the distribution of habitats changes and brackish and oligohaline regions may contract. With water supplies becoming increasingly questionable for the Atlanta metropolitan region, water demand from state rivers such as the Altamaha River may increase. The cumulative impacts of groundwater extraction, draining of wetlands and expanding surface water extraction are unknown. With program development funds, Sea Grant is poised to be able to respond to this issue immediately should the need arise prior to our next competition Without the Program Development funds, Georgia Sea Grant would not have the flexibility to respond to the concerns of the coastal communities for two years. The project is an essential part of the Sea Grant program. (24) Rationale : Program Development (PD) is a continuing need for NOAA Sea Grant and participating institutions. NOAA benefits because the grants nurture innovative approaches to marine issues at minimum expense. The University System of Georgia benefit because faculty and graduate students are able to explore emerging fields that often lead to expanded research opportunities. Program Development also allows Georgia institutions to respond to the crisis situations and unique opportunities for short duration rapid response research identified by clientele groups, agencies, and academic researchers.
Progress	
Summary	

Program	GA
Project Title	Reconstructing Georgia's Hurricane Record: A 260-year GIS Database of Coastal Impact
Investigators	Brian Bossak (Georgia Southern University (GSU)); Ethan Gibney (National Oceanic and Atmospheric Administration (US DOC, NOAA)); Mark Welford (Georgia Southern University (GSU));
Partner	
Description	There is a clearly defined need for better characterization of the risk of hurricane landfalls along the Georgia coast. Complacency regarding hurricanes in coastal Georgia is rampant, particularly among the general public. Part of this complacency is due to the fact that during the most recent decades, direct landfalls on the Georgia coast have been rare. However, a cursory examination of historical hurricane records suggests that this pattern has not held throughout time; the 18th and early 19th centuries are rife with examples of hurricanes wreaking havoc in areas such as Savannah, Brunswick, and St. Marys. These storms are largely excluded from return period calculations for Georgia hurricanes, suggesting that such calculations may be artificially low due to a temporally-limited data set of Georgia hurricanes, which extends from 1851 forward. Moreover, there is a need to better resolve weaker storms in the historical record which, although less of a wind hazard than stronger storms, may still pose significant flooding/storm surge hazards to residents living along the coast. Therefore, the objectives of the proposed work are to: 1) expand the dataset of tropical cyclone impacts along the Georgia coastline back to 1750, 2) generate updated return period calculations for tropical cyclones along the coast that will improve and enhance the existing knowledge of severe coastal storms and aid in risk characterization of storm impacts along the state's coastal counties, and 3) prepare GIS-generated maps of these return period projections along the Georgia coast. Within these objectives, our specific goals are to: 1) Identify, from selected data sources, tropical cyclone impacts to Georgia's coastline between 1750 and 1850; 2) Develop a long-term dataset of Georgia tropical cyclones that extends from 1750-2010 by appending to NOAA's Atlantic Basin Hurricane Database - HURDAT; 3) Calculate return intervals for each category of tropical cyclone intensity based on the expanded dataset; 4) Generate maps in a GIS depicting the return period, by intensity, for every one of Georgia's coastal counties; and 5) Publish the results of this study in peer-reviewed journals. We have assembled a team of experienced climatologists, spatial scientists, and geographers with extensive experience in working with large datasets, including specific expertise on the geospatial analysis of hurricanes and tropical cyclones. In our project proposal, each of the primary goals are detailed, along with the specific personnel involved and the deliverables that we intend to produce at the end of this two-year proposal period. We include outreach ideas and stakeholders that we intend to target with our results. Moreover, we also include rationale as to why we believe that our proposed research is a better methodological

	approach to achieving the aforementioned goals than other competing methods.
Progress	
Summary	

Program	GA
Project Title	Understanding social attitudes and prioritizing geo-spatial risks for climate adaptation outreach in coastal Georgia
Investigators	Jason Evans (Carl Vison Institute of Government (UGA)); Margaret Myszewski (University of Georgia (UGA)); Matthew Hauer (Carl Vison Institute of Government (UGA));
Partner	Camden County; Chatham County; Federal Emergency Management Agency (US DHS, FEMA); Georgia Coastal Regional Commission; Georgia Department of Natural Resources (GA DNR); Glynn County Government; Indiana University (IU); McIntosh County; University of Geor
Description	Like other low-lying coastal regions on the Southeast Atlantic coast, the communities of coastal Georgia are regarded as highly vulnerable to sea level rise and disastrous storm surges from Atlantic hurricanes. Because anthropogenic climate change is widely expected to exacerbate these issues, there is strong reason to believe that the long-term sustainability of Georgia's coastal communities requires pro-active planning for climate adaptation and associated resilience to future conditions. However, a recent focus group discussion among Glynn County officials – jointly facilitated by Georgia Sea Grant and the Carl Vinson Institute of Government in November 2010 – suggests that more work is needed to communicate and present the issue of sea level rise in terms of risk to property and infrastructure. An additional challenge suggested by the focus group – and as anecdotally reported by many coastal managers and researchers – is an apparently high degree of skepticism about the issues of climate change and, to a somewhat lesser extent, sea level rise. To address these problems, this project proposes the following four-pronged strategy of interdisciplinary research: 1) analyzing the extent to which local, state, and regional growth management policies in coastal Georgia provide opportunities and/or barriers for sea level rise adaptation; 2) projecting future development patterns in coastal counties through demographically-based population growth methods that take into account local land use controls; 3) calculating the relative amounts of risks to people, property, and infrastructure through overlays of "business as usual" development with coastal elevation maps and sea level rise models; and 4) engaging local officials in participatory development and evaluation of geo-spatial scenarios that estimate the economic impacts of sea level rise under

	different growth management assumptions. Taken together, the different project components are expected to not only advance the practice of climate and sea level rise adaptation at the local and state levels in Georgia, but to also make important methodological and theoretical contributions to the broader field of climate adaptation that is taking shape throughout the world.
Progress	Relevance: State law that may uniquely constrain, prohibit, or favor various sea level rise planning and adaptation strategies. Lawyers with training and experience in navigating these challenges and opportunities are of immense value to those wishing to influence public policy. Response: In July 2012, PI Evans worked with UGA faculty member Laurie Fowler (Institute of Ecology and College of Law) to develop a full-term project on sea level rise policy and legal issues for Fowler's Environmental Practicum, a graduate course in the UGA law school, that was held during UGA's Fall 2012 semester. A group of eight advanced law students were assigned a series of legal questions about sea level rise planning that local governments often face, with the specific goal of uncovering aspects of Georgia law. Result: Eight law students gained hands-on experience advising practitioners about legal aspects of SLR adaptation.(SCD#7 - 8 interns)
Summary	

Program	GA
Project Title	SPATIO-TEMPORAL ASSESSMENT OF TIDAL INLET AND STREAM MOVEMENTS AND THEIR INFLUENCE ON COASTAL VULNERABILITY
Investigators	Chester Jackson (Georgia Southern University (GSU)); Clark Alexander (Skidaway Institute of Oceanography);
Partner	Georgia Department of Natural Resources (GA DNR); Jekyll Island 4-H Center; Jekyll Island Authority; Little Cumberland Island Homeowners Association; National Park Service (US DOI, NPS);
Description	Over the past few decades, a number of published studies have suggested that shoreline erosion will likely intensify in response to rising global sea-levels. Furthermore, as coastal populations continue to grow and are located within or adjacent to barrier island, inlet and estuarine settings, there is an increasing need to identify the potential impacts of these systems on neighboring shorelines. High resolution studies, conducted within a Geographic Information System (GIS) framework and in the field, can help both coastal scientists and managers better understand the potential impacts of tidal inlet and stream dynamics on shoreline erosion, as well as facilitate better planning and management of select areas and/or resources threatened by such hazards. Along coastal Georgia, the movements of tidal streams and inlet systems play an important role in the evolution of barrier island, estuarine, and mainland shorelines. The behavior of

	these tidally influenced systems can increase or decrease the vulnerability of development/infrastructure to coastal erosion and flooding hazards. Only a few studies have been conducted that link changes in tidal inlet systems along the Georgia coast to barrier island and estuarine shoreline change. Furthermore, no studies exist on a regional scale that extends from the oceanfront to the mainland that quantifies historical width changes and lateral migration rates of tidal streams and their effect on estuarine shoreline erosion. Additionally, it is also unclear how these systems are responding to rising sea level. Currently, there are no high resolution data available for coastal vulnerability models that address these issues for Georgia. The primary objectives of the proposed project are to: 1) develop a solid base of historical shoreline and inlet data for Camden and Glynn Counties in Georgia; 2) determine the spatial extent of the influence of tidal inlets on shoreline erosion; 3) construct shoreline change and inlet hazard maps for barrier islands estuarine areas, and the mainland; and 4) provide outreach activities that include educating scientists, managers and non-science-oriented stakeholders concerned with coastal issues. Ultimately, datasets, methodologies, and geospatial tools developed within this study can be used by researchers, policymakers, planners, and managers.
Progress	
Summary	

Program	GA
Project Title	Paleotempestology of Coastal Georgia: A Study of Spatial and Temporal Variability of Hurricane Activity along the Coast of Georgia
Investigators	Lawrence Kiage (Georgia State University (GSU));
Partner	
Description	The goal of this project is to use geological multi-proxy data to determine the spatial and temporal variations in hurricane activity in the US Atlantic coast (specifically the coast of Georgia) at interannual to millennial timescales and their relationship to global and regional climate changes. The study is based on the principles and methodology of paleotempestology, a young but blossoming field of science that studies past hurricane activity mainly by means of geological proxy techniques. Different studies have proven geological proxy data such as overwash sand layers, diatoms, foraminifera, pollen, and phytoliths collected from appropriate coastal lakes and marshes to be excellent for

	reconstruction past hurricane events. Situated on the US Atlantic coastline, the coastal areas of Georgia are potentially subject to the severe effects of hurricane landfalls. Instrumental records of landfalling hurricanes in the western North Atlantic, however, are essentially limited to the last 160 years. The dearth of long-term records compounded with the infrequency of intense coastal hurricanes leads to a large uncertainty in estimates of probabilities for occurrence of extreme events. These probabilities are crucial for a variety of activities including emergency planning, and other purposes such as designing and implementing hurricane-resistant building codes, planning evacuation routes, and setting insurance rates. Salt marshes on the barrier islands along the Georgia coast are well positioned to record and preserve hurricane overwash events and can therefore serve as superb paleoweather stations that can extend the record of hurricane landfalling activity. During the proposed fieldwork expedition I plan to use the Livingstone and vibra corers to raise a series of sediment cores from select lakes and marshes from four barrier islands (Cumberland, Little St. Simons, Wassaw, and St. Catherines) along the Georgia coast. The cores will yield long-term proxy data that are necessary for studying the varying patterns among hurricanes that make landfall in the U.S. Atlantic coast at different timescales. An important scientific goal of this project is to determine the balance of mechanisms that control the spatial and temporal variability of hurricane activities (frequency, intensity, tracks, and range) in the US Atlantic coast. This study will produce the first comprehensive paleotempestological record from coastal Georgia based on multiple proxies and multiple study sites, and provide information on the return rate of intense hurricanes in coastal Georgia. By establishing a long-term record of intense hurricanes this study specifically addresses one of the key areas identified for study by the Georgia Sea Grant Advisory Committee. This project has many contributions that are aligned with the priorities of the Georgia Sea Grant Program. The findings of the study will address matters of great societal relevance: "How vulnerable are the coastal areas of Georgia to destructive strikes by intense hurricanes (category 3 and above)?" Or put differently, what is the likelihood of a city on the Georgia coast, such as Savannah or Brunswick, being hit by a catastrophic hurricane? The research questions addressed in the study also constitute topics for Master of Science theses in Geosciences at Georgia State University from which a graduate student in Georgia will gain an advanced degree in geosciences. The project will raise public awareness that intense hurricanes have and will impact the GA coast. The results from this project will be disseminated through outreach activities targeting different stakeholders in Georgia as well as presentation of papers at international conferences and publication in peer-reviewed scientific journals.
Progress	
Summary	

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	HI
Project Title	Regional Extension Network Support for the Republic of the Marshall Islands
Investigators	Darren Lerner (Hawaii Sea Grant);
Partner	
Description	GOALS AND OBJECTIVES: The overall goal is to establish a pilot coastal management program as a joint initiative of the University of Hawaii Sea Grant College Program (Hawaii Sea Grant) and the College of the Marshall Islands (CMI), with support of major government agencies and local non-governmental organizations (NGOs), to protect the natural resources and island economy of the Republic of the Marshall Islands (RMI) and provide a regional model for future replication in other areas. Specific objectives include: 1) issue identification and risk assessment related to coastal hazards; 2) increased public awareness of coastal issues and mitigation strategies; 3) developing strategies for coastal resiliency; and 4) development and selected implementation of best management practices for coastal economic activities. This work also includes a strong educational and capacity building component. EXTENSION METHODS/APPROACH: A Coastal Management Extension Agent position will be established as a joint appointment between Hawaii Sea Grant and CMI to lead the initiative in tandem with the Coastal Management Advisory Committee (CMAC), a multi-institutional local advisory board, and the private sector. Activities will include research and studies on coastal processes, public outreach, extension, formal educational activities, and liaising with other technical specialists and relevant regional initiatives. The agent will also assist CMI in developing a coastal management curriculum and will assist in teaching a limited number of classes in this area to build future local capacity. RATIONALE: The Pacific Islands, particularly low-lying atolls, are extremely vulnerable to changes associated with coastal processes and natural hazards. Global climate change and sea level rise are of obvious concern. The RMI consists of 29 atolls and four islands and 750,000 square miles of Exclusive Economic Zone and represents one of the most fragile Pacific Island nation vis-à-vis coastal hazards. The RMI is also confronted with a series of threats associated with rapid urban and industrial development that exemplify a common scenario found throughout the Pacific Islands. On the positive side, the RMI has demonstrated a collective increase in capacity and willingness to address difficult challenges, improve governance and commit resources to collaborative efforts. This work continues and expands 20 plus years of partnership between Hawaii Sea Grant and partners in the U.S.-affiliated Territories and Freely Associated States. Hence an initiative focused on the RMI can address local needs and serve a model for other nations in the Pacific region which face similar issues and challenges.
Progress	RELEVANCE: The Republic of the Marshall Islands consist of low-lying atolls which are extremely vulnerable to changes associated with coastal processes and natural hazards. Global climate change and sea level rise are of obvious concern.

	The RMI is also confronted with a series of threats associated with rapid urban and industrial development that exemplify a common scenario found throughout the Pacific region. RESPONSE: With funding support from the NOAA National Sea Grant Office (NSGO), Hawaii Sea Grant established a partnership with the College of the Marshall Islands to create an extension agent position at the college. Dr. Murray Ford was hired in March 2009 and participated in various activities that included engaging local resource management organizations, conducting coastal processes/climate adaptation research and outreach, instructing GIS and coastal management courses at CMI; and serving as a liaison for scientists and resource managers conducting research/outreach projects including regional initiatives such as the Pacific Island Ocean Observing System. RESULTS: Dr. Ford left the position in December 2011 to assume a full-time teaching faculty position at Auckland University where he continues to this day to conduct research in the Marshall Islands. The NSGO committed to funding this project for an additional two years. In response Hawaii Sea Grant conducted a recruitment to fill the extension agent position and hired Dr. Karl Fellenius, who is expected to start in May 2013.
Summary	Hawaii Sea Grant and the College of the Marshall Islands continued their partnership to co-share an extension agent position seconded at the college to mitigate coastal hazards and support climate change adaptation strategies.

Program	HI
Project Title	Pacific Islands Coastal Storms Program Education and Outreach Cooperative Agreement
Investigators	Dolan Eversole (Hawaii Sea Grant); E. Gordon Grau (Hawaii Sea Grant);
Partner	
Description	RATIONALE: The Coastal Storms Program (CSP) is a nationwide effort currently focusing on community hazard resilience in the U.S. Pacific Island region's coastal communities to help reduce and mitigate the risk from coastal storm and weather hazards and climate change. The CSP has a history of facilitating interagency and organization partnerships with regional significance. Hawaii and the U.S. Affiliated Pacific Islands include low-lying atolls and islands that are especially vulnerable to coastal storms and climate-based hazards. The Coastal Storm Program provides outreach and coordination support to Hawai'i and the U.S. Pacific Islands region by examining the processes and conditions that create and maintain hazard risks (vulnerability assessment), and by identifying technological and socio-economic strategies and solutions to reduce individual and community vulnerability through measures that improve adaptation/mitigation and community resilience. The Pacific Risk Management 'Ohana (PRiMO) is a coalition of Pacific

region organizations with a role in hazard risk management. The agencies and institutions that comprise PRiMO represent a broad collection of organizations that recognize the value of collective action and are committed to enhancing cooperation, coordination, and collaboration to strengthen and sustain hazard resilient communities. PRiMO is based on a mutual recognition of the benefits of collective action with activities that are characterized by shared leadership and shared resources. PRiMO is comprised of representatives from local, national, and regional agencies, institutions, organizations, and academia engaged in building disaster resilient communities in the Pacific Islands. PRiMO Partners work together to help leverage resources, data and other vital information to create projects and services that reduce risk and increase community resilience. PRiMO partnerships have improved product development and service delivery, strengthened the regional capacity to manage hazard risks, and resulted in significant cost savings by minimizing duplication of effort and improving efficiency. PRiMO began in 2003 as an effort to simply explore opportunities to enhance communication and collaboration among the 'ohana, or family, of local, national, and regional agencies, institutions, and organizations involved in risk management in the Pacific. PRiMO has since transformed into a true collaborative effort governed by a coordinating council of Navigators. These key representatives from the region provide leadership, resources, and policy guidance to PRiMO as well as seek institutional support for PRiMO from within their respective organizations. GOALS & OBJECTIVES: The goal of the Pacific Region Coastal Storms Program is to provide better coordination, communication, awareness, and understanding of coastal hazard risks and community resilience such as coastal land-use and resiliency to coastal hazards and climate change through education and product transition, specifically with regards to coastal inundation and community resilience. The CSP strives to improve community capacity to prepare for and respond to coastal hazards including climate change impacts by helping public and private decision-makers create and adopt policies, plans, and ordinances, and by communicating information on how to prepare for and mitigate these impacts. The NOAA Pacific Islands Region Coastal Storms Program (CSP) is aligned with NOAA and partner organizations such as PRiMO to enhance community resilience to storm-related hazards and climate change impacts (i.e., sea level rise) in the region. Similarly, the goal of PRiMO is to increase collaboration to improve the development, delivery, and application of risk management products and services for Pacific communities. METHODOLOGY: In support of the goals and objectives for both the NOAA CSP and PRIMO stated above we propose to promulgate the mutual mission of the CSP and PRiMO through support of the annual meeting to convene all the partners. The PRiMO annual meeting is planned for March 13-15th, 2012 in Honolulu Hawaii. The NOAA CSP support for the meeting will go toward room rental and associated conference hosting fees. EXPECTED OUTCOMES/IMPACTS: The CSP program is improving coastal community hazard awareness and preparedness and decision maker's access to and utilization of data and innovative and adaptive tools and techniques to minimize coastal hazard risks. The PRiMO meeting will result in improved coordination of various international hazard programs and projects as a direct result of the CSP support. One of the most important tools for enhancing coastal community resilience to hazards is through development and fostering of partnerships and communication. This in turn, improves coastal decision-makers and communities' capacity for application of data and resources to hazard planning and response. Incorporation of climate

	change data and adaptation techniques will become a prominent effort at the federal, state and county level of government. This will be carried out through outreach and project partnership in coordination with PRiMO partners. This will result in improvement of knowledge and skills to assess local risk vulnerability and respond with appropriate policies and regulations primarily related to climate change adaptation. PRiMO partners and CSP stakeholders will benefit from improved risk communication and understand the benefits of coastal hazard risk planning, and will be aware of existing and available hazard-related data and resources. Stakeholders will have improved awareness and understanding of the physical processes that produce hazards and climate change, and the associated uncertainties and limitations thus improving stakeholder's capacity to address, mitigate and respond to coastal hazards and climate change.
Progress	
Summary	

Program	HI
Project Title	Coastal Community Climate Adaptation Initiative: Enhancing Sea Grant's Ability to Help Coastal Communities Adapt to Climate Change
Investigators	
Partner	
Description	RATIONALE: The town of Kailua is located on the windward side of the island of Oahu, in the City and County of Honolulu, Hawaii. With a discrete and interested population, Kailua presents a unique opportunity to develop an innovative model to develop place based recommendations and strategies for climate adaptation. Communities in Hawaii typically develop community level general plans which are intended to implement community priorities and goals. Developing a model for climate adaptation recommendations and strategies with the Kailua community will assist Kailua in tailoring their community plans to better fit their distinct, place based needs and priorities, while also serving as a model for state-wide application of climate change adaptation strategies. GOALS AND OBJECTIVES: Although the initial focus will be in Kailua, Hawaii, the primary objective of the Kailua Community Climate Adaptation Recommendations and Strategies (Kailua CCARS) is to develop a model by which communities throughout Hawaii will be

	provided with sufficient information and options to consider future planning alternatives. These recommendations and strategies will enable them to make better informed decisions, and ultimately lead to the development and implementation of customized solutions to the natural hazards and climate change challenges that threaten their economic and social well-being. A critical step in this process is to identify and engage local experts as well as tapping regional and/or national expertise as needed to support these efforts. The Kailua CCARS will identify best practices and coastal land use policies enabling the University of Hawaii Sea Grant College Program (UH Sea Grant) to focus its subsequent efforts in coastal community climate change adaptation activities shown to have the greatest benefit. METHODOLOGY: - Community survey: created, mailed out, and face-to-face surveys. - Survey results: data base creation, analysis, summary of results organized to assist in creation of draft recommendations and strategies - Draft Kailua Community Climate Adaptation Recommendations and Strategies: digital copy posted online - Public meeting results: short write up, analysis and summary of comments, suggestions for revising recommendations and strategies - Final Kailua Community Climate Adaptation Recommendations and Strategies: digital copy, 50 print copies, Appendices (Kailua Beach and Dune Management Plan, Survey, Survey Results, Meeting results), References - Summary Report: process, feedback, results, and lessons learned EXPECTED OUTCOME: - Creation of a UH Sea Grant Center of Excellence for Island Climate Adaptation and Policy (ICAP) - Participation in the Sea Grant Climate Network - Hawaii's Changing Climate (briefing sheet) - ICAP Ocean and Coastal Climate Impacts for Hawaii (draft report)\ - Climate impacts public workshop on Kauai, November 2009 - Inauguration of Coastal Storms Program for the Pacific Region administered by UH Sea Grant in partnership with the NOAA Coastal Storms Program - Sea-level rise inundation pilot study for Honolulu - US Agency for International Development Asia Pacific Climate Change Adaptation Needs Assessment report - University of Rhode Island/College of the Marshall Islands/Pacific Aquaculture Coastal Resources Center at the University of Hawaii at Hilo/UH Sea Grant work on climate change adaptation in the Republic of the Marshall Islands - Future development of sea-level rise inundation maps with associated risk and vulnerability analysis for limited areas of Hawaii - Assisting the NOAA Pacific Services Center with the development of Climate Adaptation Training Modules for Hawaii - Implementation of Climate Adaptation Training Modules in targeted communities - Assisting the Ocean Resource Management Plan working group with development of a Climate Adaptation Framework for the state - National Marine Fisheries Service/Sea Grant partnership to develop a case study on the impacts and implications of future climate change on fisheries sustainability in Hawaii and the western and central Pacific - Participation in a NOAA-Korea Joint Project Agreement workshop on coastal erosion and climate adaptation in the Republic of Korea
Progress	Relevance: Kailua presents a unique opportunity to develop an innovative model to develop place based recommendations and strategies for climate adaptation. Communities in Hawaii typically develop community level general plans which are intended to implement community priorities and goals. Developing a model for climate adaptation recommendations and strategies with the Kailua community will assist Kailua in tailoring their community plans to better fit their distinct, place based needs and priorities, while also serving as a model for state-wide application of climate change adaptation strategies. Response: UH Sea Grant working with a vast array of stakeholders

	and researchers endeavored to develop a Beach Management Plan for Kailua, HI. Results: Completed the Kailua Beach management Plan
Summary	Although the initial focus will be in Kailua, Hawaii, the primary objective of the Kailua Community Climate Adaptation Recommendations and Strategies (Kailua CCARS) is to develop a model by which communities throughout Hawaii will be provided with suffici

Program	HI
Project Title	Coastal Community Climate Adaptation Initiative: Enhancing Sea Grant's Ability to Help Coastal Communities Adapt to Climate Change
Investigators	
Partner	
Description	RATIONALE: The town of Kailua is located on the windward side of the island of Oahu, in the City and County of Honolulu, Hawaii. With a discrete and interested population, Kailua presents a unique opportunity to develop an innovative model to develop place based recommendations and strategies for climate adaptation. Communities in Hawaii typically develop community level general plans which are intended to implement community priorities and goals. Developing a model for climate adaptation recommendations and strategies with the Kailua community will assist Kailua in tailoring their community plans to better fit their distinct, place based needs and priorities, while also serving as a model for state-wide application of climate change adaptation strategies. GOALS AND OBJECTIVES: Although the initial focus will be in Kailua, Hawaii, the primary objective of the Kailua Community Climate Adaptation Recommendations and Strategies (Kailua CCARS) is to develop a model by which communities throughout Hawaii will be provided with sufficient information and options to consider future planning alternatives. These recommendations and strategies will enable them to make better informed decisions, and ultimately lead to the development and implementation of customized solutions to the natural hazards and climate change challenges that threaten their economic and social well-being. A critical step in this process is to identify and engage local experts as well as tapping regional and/or national expertise as needed to support these efforts. The Kailua CCARS will identify best practices and coastal land use policies enabling the University of Hawaii Sea Grant College Program (UH Sea Grant) to focus its subsequent efforts in coastal community climate change adaptation activities shown to have the greatest benefit. METHODOLOGY: - Community survey: created, mailed out, and face-to-face surveys. - Survey results: data base

	creation, analysis, summary of results organized to assist in creation of draft recommendations and strategies - Draft Kailua Community Climate Adaptation Recommendations and Strategies: digital copy posted online - Public meeting results: short write up, analysis and summary of comments, suggestions for revising recommendations and strategies - Final Kailua Community Climate Adaptation Recommendations and Strategies: digital copy, 50 print copies, Appendices (Kailua Beach and Dune Management Plan, Survey, Survey Results, Meeting results), References - Summary Report: process, feedback, results, and lessons learned EXPECTED OUTCOME: - Creation of a UH Sea Grant Center of Excellence for Island Climate Adaptation and Policy (ICAP) - Participation in the Sea Grant Climate Network - Hawaii's Changing Climate (briefing sheet) - ICAP Ocean and Coastal Climate Impacts for Hawaii (draft report)\ - Climate impacts public workshop on Kauai, November 2009 - Inauguration of Coastal Storms Program for the Pacific Region administered by UH Sea Grant in partnership with the NOAA Coastal Storms Program - Sea-level rise inundation pilot study for Honolulu - US Agency for International Development Asia Pacific Climate Change Adaptation Needs Assessment report - University of Rhode Island/College of the Marshall Islands/Pacific Aquaculture Coastal Resources Center at the University of Hawaii at Hilo/UH Sea Grant work on climate change adaptation in the Republic of the Marshall Islands - Future development of sea-level rise inundation maps with associated risk and vulnerability analysis for limited areas of Hawaii - Assisting the NOAA Pacific Services Center with the development of Climate Adaptation Training Modules for Hawaii - Implementation of Climate Adaptation Training Modules in targeted communities - Assisting the Ocean Resource Management Plan working group with development of a Climate Adaptation Framework for the state - National Marine Fisheries Service/Sea Grant partnership to develop a case study on the impacts and implications of future climate change on fisheries sustainability in Hawaii and the western and central Pacific - Participation in a NOAA-Korea Joint Project Agreement workshop on coastal erosion and climate adaptation in the Republic of Korea
Progress	Relevance: Kailua presents a unique opportunity to develop an innovative model to develop place based recommendations and strategies for climate adaptation. Communities in Hawaii typically develop community level general plans which are intended to implement community priorities and goals. Developing a model for climate adaptation recommendations and strategies with the Kailua community will assist Kailua in tailoring their community plans to better fit their distinct, place based needs and priorities, while also serving as a model for state-wide application of climate change adaptation strategies. Response: UH Sea Grant working with a vast array of stakeholders and researchers endeavored to develop a Beach Management Plan for Kailua, HI. Results: Held two of the first workshops in Hawaii jointly with the NOAA Coastal Services Center to focus on climate adaptation in sustainable coastal development.
Summary	Although the initial focus will be in Kailua, Hawaii, the primary objective of the Kailua Community Climate Adaptation Recommendations and Strategies (Kailua CCARS) is to develop a model by which communities throughout Hawaii will be provided with suffici

Program	HI
Project Title	Bioeroding Communities and Response to Climate Change
Investigators	
Partner	
Description	RATIONALE: Bioerosion is the natural process by which marine organisms break down the calcium carbonate reef framework through grazing and boring. Bioerosion influences the accretion-erosion balance, mechanical stability, and structural complexity of coral reef ecosystems, which are critical to the economic services these ecosystems provide, including shoreline protection, seafood, and tourism. Human activites, such as eutrophication from coastal development and ocean acidification, may enhance bioerosion and jeopardize reef resilience and the services provided by coral reef ecosystems. Bioerosion rates are known to be affected by nutrient availability, pCO2 and accretion of crustose coralline algae, and predator density, which are modified by coastal development, atmospheric carbon dioxide, and overfishing, respectively. However, very little is known about the relative contribution of each of these local and global stressors on bioeroder community composition and bioerosion rates in the Hawaiian Archipelago. This proposal aims to distinguish the effects of ocean acidification and natural environmental variation on bioerosion using a novel method that combines several new technologies. GOALS AND OBJECTIVES: 1) Measure bioerosion rates across the Hawaiian Archipelago, characterizing variation in bioerosion rates and bioeroder community composition. 2) Take advantage of natural, fine-scale variation in lagoonal reefs to examine how bioerosion rates and bioeroder community composition responds to environmental variables and test whether bioeroding communites are good indicators of local and global stressors. 3) Using a mesocosm experiment, specifically test how bioerosion rates will respond to ocean acidification. METHODOLOGY: Across the Hawaiian Archipelago, small blocks of coral skeleton will be deployed on five sites at each of five islands for a year. These blocks will be scanned before and after deployment using micro-computed tomography (µCT) to accurately determine bioerosion rates and associate patterns of bioerosion with the bioeroder community. Using ReefChip, a microarray with species-specific probes, we will identify the community composition of bioeroders in each block. These experimental deployments will be matched with field collections of the in-situ bioeroder community. In Kaneohe Bay, we will work at a smaller scaller, within a lagoonal reef, to characterize the environment of bioeroding communities at the fine spatial and temporal scale at which they experience it. Pairing ReefChip and µCT technologies with the an environmental sensor array, ReefSense, we will measure how fine-scale spatial and temporal variation in water quality (oxygen, pH, chlorophyll, nutrients, etc) influences the bioerosion rates and community composition.

	Finally, we will use a set of pCO2-controlled mesocosms to specifically test bioerosion response to ocean acidification. EXPECTED OUTCOME: In addition to providing managers information on current and predicted rates of bioerosion on reefs in the Hawaiian Archipelago, this proposal develops a straightforward method for managers to monitor changes in bioerosion throughout the Pacific.
Progress	
Summary	

Program	HI
Project Title	Collaborative Research to Develop Sustainable Ecosystem Management: Analysis of Water Resources and Quality in the Contemporary Ahupua'a
Investigators	
Partner	
Description	RATIONALE: Coastal communities in the Hawaiian Islands have a common set of problems related to global climate change and increased population growth including impacts on water resources, water quality and down-stream coastal ecological health. Faced with these challenges that are likely to increase in the future, we need to develop policies and management approaches that are culturally appropriate, acceptable to the community, and based on sound social and natural scientific research to promote the conservation and use of near-shore resources. In this project we will collaborate with a community organization Kākoʻo ʻŌiwi, committed to the restoration of loʻi kalo (wetland taro fields) to develop a dynamic responsive framework for sustainable management that includes current scientific exploration that we call the "contemporary ahupuaʻa". GOALS AND OBJECTIVES: To begin the development of an integrated plan for the contemporary ahupuaʻa we will address these overarching goals: 1) Asses and evaluate Kākoʻo ʻŌiwi's current management framework and community outreach programs, 2) Determine water resources and projected availability in the watershed with respect to current land-use and proposed restoration efforts within future climate projections, 3) Determine the current state and the impacts of the restoration on water quality within the loʻi and downstream habitats, 4) Develop dynamic and responsive strategies for integration of science, indigenous politics, and community objectives. METHODOLOGY: We will combine hydrology, ecosystem function and indigenous politics in an integrated

	research and outreach plan. We will use questionnaires, isotope, analysis, and modeling techniques and develop a series of workshops and cross training to increase interaction among disciplines and between researchers and the community. EXPECTED OUTCOME: This project addresses three major areas of Sea Grant interest: it provides strong links between interdisciplinary researchers and offers a new approach to coastal management that incorporates community. The final product will be a culturally relevant model that incorporates both scientific and traditional ecological knowledge.
Progress	Relevance: Coastal communities in the Hawaiian Islands have a common set of problems related to global climate change and increased population growth including impacts on water resources, water quality and down-stream coastal ecological health. Faced with these challenges that are likely to increase in the future, we need to develop policies and management approaches that are culturally appropriate, acceptable to the community, and based on sound social and natural scientific research to promote the conservation and use of near-shore resources. Response: To develop an integrated plan for the contemporary ahupua?a by addressing the following goals: 1) Asses and evaluate Kako?o ?Oiwi?s current management framework and community outreach programs, 2) Determine water resources and projected availability in the watershed with respect to current land-use and proposed restoration efforts within future climate projections, 3) Determine the current state and the impacts of the restoration on water quality within the lo?i and downstream habitats, 4) Develop dynamic and responsive strategies for integration of science, indigenous politics, and community objectives. Results: 1. Assessed best approaches for modeling and combining watershed and groundwater models to accomplish project goals and trained graduate trainee on use of the GMS hydrogeological model. 2. collected information from community on existing and planned water diversions, location of historic springs and landscapes and determined best locations for long-term water level monitoring of the stream and groundwater within the taro fields. 3. Established and deployed 3 piezometers across the ahupua`a for long-term monitoring of groundwater level, conductivity and temperature using CTD divers, 1 CTD diver to monitor water level, conductivity and temperature in He`eia stream at the taro fields, and a weather station near the taro field that monitors weather every 15-minutes. These data will be used to construct a watershed model, and will be shared with the Kako`o `Oiwi community.
Summary	This work combines hydrology, ecosystem function and indigenous politics in an integrated research and outreach plan. Through the use of questionnaires, isotope, analysis, and modeling techniques and the development of a series of workshops and cross trai

Program	HI
Project Title	Historical Shoreline Change Among the Islands of Micronesia and Polynesia: Long-term Patterns and Response to a Change in Sea-Level Rise

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Investigators	
Partner	
Description	RATIONALE: The global average rate of sea-level rise has accelerated from 1-2 mm/yr to approximately 3 mm/yr over the past 50 years (Merrifield et al, 2009). However, regional sea level is highly variable and some areas are experiencing rates of rise several times faster than the global average. One of these is the western tropical Pacific where island communities are being impacted by sea level rise of 8 to 12 mm/yr. The change from 20th century rates (~1-2 mm/yr) to 21st century rates (~8-12 mm/yr) in this region provides a chance to document shoreline response to accelerated sea-level rise using aerial photography over the period WWII to present. Improved understanding of shoreline response to accelerated sea-level rise can be used in Hawai'i and elsewhere to better prepare for, and ultimately manage, the impacts of higher rates of sea level rise expected in coming decades. GOALS AND OBJECTIVES: The primary goal of this study is to document shoreline change in response to accelerated rates of sea-level rise. The improved understanding of shoreline processes will inform management planning throughout the Pacific and elsewhere. We will collect time-series of coastal aerial photography from a cross-section of western Pacific islands (principally Guam and Palau in the first effort), rectify the images, vector representative shoreline features, quantify errors and uncertainties, and model shoreline change. A main objective is to produce knowledge that is useful to coastal managers, assess coastal processes that might account for changes in shoreline position, model the data to further identify processes and patterns, and provide communities and agencies with this information to assist in the development of coastal management plans and sea level adaptation strategies. We will train a PhD student and publish results in peer-reviewed scientific literature. METHODOLOGY: Methods include digital orthorectification of historical aerial photographs, statistical modeling of shoreline change rates, numerical modeling of shoreline change patterns and sedimentary processes. Rates are modeled at an alongshore spacing designed to produce a detailed, high-resolution dataset of erosion and accretion trends. The time history of rates comes from sets of photographs that depict shorelines since WWII EXPECTED OUTCOME: This study will result in the following: publication of at least one paper in a peer-reviewed scientific journal; training of at least one graduate student; improved understanding of how sandy shorelines respond to acceleration in the rate of sea level rise; and a dataset and generalized knowledge that is useful for Pacific coastal managers, and mangers elsewhere, as they prepare for an anticipated acceleration in the rate of sea level rise in other regions.
Progress	
Summary	

Program	HI
Project Title	Factors Controlling Temporal and Spatial Variability of Air-Sea CO2 Fluxes in a Coral-Dominated Reef Ecosystem: Kaneohe Bay, Hawaii
Investigators	
Partner	
Description	RATIONALE: Despite their dynamic biogeochemical cycles, coastal ecosystems, particularly in tropical and sub-tropical regions, remain understudied, and current estimates of air-sea CO2 fluxes from the coastal ocean are still subjected to large uncertainties. One of the important shortcomings in present-day estimates of air-sea CO2 fluxes in coastal environments is the lack of agreement between the different parameterizations of gas transfer velocity (k) as a function of wind speed and there is a scientific need for direct in situ measurements of k in coastal sites in order to accurately calculate air-sea fluxes of CO2 and other greenhouse gases. Given that coastal ecosystems are undergoing accelerated changes caused by natural and anthropogenic processes, it is crucial to develop a knowledge base in order to predict how these changes will alter carbon cycling and air-sea CO2 fluxes in coastal ecosystems. GOALS AND OBJECTIVES: Here we propose to perform a comprehensive field study with the main goal of investigating the physical and biogeochemical factors responsible for temporal and spatial variability of air-sea CO2 fluxes in a coral reef ecosystem: Kaneohe Bay, Hawaii. We also aim to examine the impact of storm-induced runoff on water column biological productivity and air-sea CO2 fluxes. We will apply the dual tracer (3He/SF6) technique to quantify, for the first time in this environment, the residence time of the water and the gas transfer velocities, which will allow us to accurately calculate air-sea gas fluxes. METHODOLOGY: We will measure gas transfer velocities in the southern and central sectors of Kaneohe Bay by using the 3He/SF6 dual tracer technique. SF6 in the water will be measured underway using an automated system connected to a gas chromatograph with an electron capture detector. During the surveys, pCO2 in the air and water will be measured with a non-dispersive infrared (NDIR) analyzer coupled to a deck mounted shower head chamber; dissolved O2 will be recorded continuously with an Aanderaa optical sensor, and pH will be measured at high frequency with a Methrom glass combination electrode. EXPECTED OUTCOME: The dual tracer technique will allow us to quantify for the first time the water residence times and gas transfer velocities in different sectors of Kaneohe Bay. The latter will allow a more accurate determination of CO2 air-sea fluxes. Baseline knowledge of the mechanisms controlling air-sea CO2 fluxes in coastal ecosystems is crucial to be able to predict how on going and future anthropogenic environmental changes will affect the carbon cycling in these environments.
Progress	Relevance: Despite their dynamic biogeochemical cycles, coastal ecosystems, particularly in tropical and sub-tropical

	regions, remain understudied, and current estimates of air-sea CO2 fluxes from the coastal ocean are still subjected to large uncertainties. One of the important shortcomings in present-day estimates of air-sea CO2 fluxes in coastal environments is the lack of agreement between the different parameterizations of gas transfer velocity (k) as a function of wind speed and there is a scientific need for direct in situ measurements of k in coastal sites in order to accurately calculate air-sea fluxes of CO2 and other greenhouse gases. Given that coastal ecosystems are undergoing accelerated changes caused by natural and anthropogenic processes, it is crucial to develop a knowledge base in order to predict how these changes will alter carbon cycling and air-sea CO2 fluxes in coastal ecosystems. Response: To perform a comprehensive field study investigating the physical and bio-geochemical factors responsible for temporal and spatial variability of air-sea CO2 fluxes in a coral reef ecosystem: Kaneohe Bay, Hawaii. We also aim to examine the impact of storm-induced runoff on water column biological productivity and air-sea CO2 fluxes. We will apply the dual tracer (3He/SF6) technique to quantify, for the first time in this environment, the residence time of the water and the gas transfer velocities, which will allow us to accurately calculate air-sea gas fluxes.Results: Conducted and analyzed SF6 tracer release experiment in the central and southern portions of Kaneohe Bay to examine the water residence time and examine the spatial variability in pCO2 and DO. After injecting SF6 in the south bay on Day 0, we surveyed the tracer for 6 days using an automated underway SF6 analysis system as it was transported around the south bay and also as it was flushed into the central bay. We made simultaneously measurements of pCO2 and DO using an underway pCO2 system and an oxygen optode.
Summary	UH Sea Grant researchers are studying factors that control the variability of carbon dioxide concentrations in Kaneohe Bay, and examining factors that determine the air-sea fluxes of carbon dioxide in and out of the bay. This goal is to provide a framewor

Program	HI
Project Title	The Economic Consequences of Coastal Disasters
Investigators	Noy, Ilan (University of Hawaii at Manoa, College of Social Sciences);
Partner	
Description	RATIONALE: In spite of a long history of coastal disasters, including several in the State of Hawaii, we are still fairly uninformed about the longer-term economic consequences of these events. This lack of knowledge was very evident in

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<td>the aftermath of the March 2011 Sendai earthquake, when media reports wildly oscillated between doomsday scenarios for the Japanese economy to 'nothing-to-mild' impact predictions as well. Almost all of the research on the economic toll of disasters focuses on the short-term – i.e., the immediate impact of the disaster. The long-term impacts of natural disasters are "hidden" since distinguishing them from other post-disaster developments is difficult. A decade after an event, how many of the observed changes in an economy can confidently be attributed to the event itself? GOALS AND OBJECTIVES: In this proposed project we would like to focus on the 1960 tsunami and the 1992 hurricane Iniki's ex post long-term impact on the economies of the Hilo region and the Island of Kauai, respectively. Three deliverable goals will emerge from this project. The first will be a macroeconomic-regional dataset for the Hilo region and its comparison group for the years 1950-1980 (the dataset will be made publicly available on the UHERO website). The second will be a statistical/econometric analysis of this data that should yield a set of estimates of the impacts of the 1960 tsunami and the 1992 hurricane on the economies of Hilo and Kauai, respectively (these will be published in refereed venues). The third will be a set of predictions regarding the future likely impacts of future coastal disasters in Hawaii; measured in terms of economic activity, tax revenue, prices, and population movements. METHODOLOGY: We first construct, from primary sources, a dataset for the State of Hawaii and its constituent counties for the period surrounding the 1960 Hilo tsunami. Next, in order to separate the effect of the natural disaster from the effect of external and local factors we need to establish a counterfactual scenario for Hilo/Kauai without the disaster. We plan to employ a methodology formalized in Abadie et al. (2010) and used therein to examine California's tobacco control legislation. A key element of this synthetic control methodology is the presence of an appropriate control group, in our case the other Hawaiian islands/counties. In the last stage, we will use the results obtained in the second stage, together with a modeling of the initial disaster likelihood and likely impacts in order to quantify the anticipated future long-term effects of current climate projections. EXPECTED OUTCOME: Outcomes include the first estimates of the long-term costs of large coastal disasters. We expect these to improve public planning not only in Hawaii but also in other coastal regions that are exposed to similar hazards. In addition to accounting for past costs, we will also be able to make predictions regarding the likely impacts of future coastal disasters in Hawaii: these will be measured along a much broader spectrum of outcomes than previously considered. The accounting and prediction components will not only aid in cost-benefit analysis of mitigation and/or prevention programs, but also by informing policies designed to achieve economic recovery after a disaster has occurred. Finally, an important outcome will be raising the awareness of the both the general public and policymakers of the true long-term costs of coastal disasters.</td>
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<td>**Progress**</td>
<td>Relevance: Almost all of the existing research on the economic toll of disasters focuses on the short-term – i.e., the immediate impact of the disaster or in the first couple of years. The long-term impacts of natural disasters are "hidden" since distinguishing them from other post-disaster developments is difficult. Response: We introduce a newer and more appropriate methodology that enables a better accounting of the long-term economic impacts of the coastal disasters we consider. Results: To date this work has resulted in three peer-reviewed publications. One paper has been accepted for publication (to be published in 2013 - Forces of Nature and Cultural Responses, Pfeifer and Pfeifer (eds.), Springer)</td>
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	and two additional papers are currently under review. The authors have been invited to present their work at the World Cliometrics Conference 2013 and are currently organizing a public outreach session at the Pacific Tsunami Museum in Hilo to describe the results of their research to date.
Summary	In spite of a long history of coastal disasters, including several in the State of Hawaii, we are still fairly uninformed about the longer-term economic consequences of these events. This lack of knowledge was very evident in the aftermath of the March 20

Program	HI
Project Title	Coral Resilience in Hotter, More Acidic Oceans
Investigators	
Partner	
Description	RATIONALE: The release of anthropogenic CO_2 to the environment is leading to climate change and ocean acidification (OA), with potentially severe repercussions for coral reefs and for society. Hawaii derives ~$364 million annually directly from coral reefs in addition to other benefits, such as shoreline protection. Because corals are ecosystem engineers, their health is especially important to maintaining Hawaiian coastal fisheries productivity. Understanding the impacts of global climate change on coral reefs is, therefore, of major scientific and societal importance. GOALS AND OBJECTIVES: The purpose of this study is to examine the effects of high-temperature and low-pH stress on coral physiology and growth. We will determine the importance of coral species, coral host genotype, coral symbiont (zooxanthellae) clade in conferring tolerance to temperature and pH stressors. We will also determine the importance of food availability and feeding rate in conferring coral tolerance to environmental stressors. Specifically, we will test the following hypotheses: (H1): sensitivity to elevated temperature and reduced pH vary according to coral species, host genotype and dominant symbiont type; (H2): coral resilience to bleaching varies with prey availability in heterotrophically plastic species, but not in non-plastic species; and (H3): coral sensitivity to reduced pH varies with feeding rate. METHODOLOGY: We will use three of the most abundant reef-building corals in the Hawaiian archipelago, Montipora capitata, Pocillopora damicornis, and Porites compressa for these experiments. This study will be conducted in a state-of-the-art flow-through aquarium system that includes 24 insulated aquaria (~50 L each) with fine-scale independent temperature and pCO_2 control. Tank experiments will be used to examine the effects of three levels of each temperature and pCO_2,

	corresponding to present-day (26.7 °C, 390 µatm corresponding to pH ~8.0) and projected values for years 2050 (28.3 °C, 560 µatm corresponding to pH ~7.9) and 2100 (29.4 °C, 840 µatm corresponding to pH ~7.75) in a fully factorial, crossed design (3temp x 3pCO2 = 9 treatments). One experiment will evaluate the impact of populations of corals from different environments whereas the other will evaluate the impact of feeding on coral resilience to these stressors. For each experiment, corals will be allowed 60 days to recover and acclimatize to the same conditions in a common flow-through seawater system prior to treatment. Temperature in each aquarium will be logged continuously, whereas light intensity, salinity, dissolved nutrients (N and P) and carbonate system parameters will be measured regularly throughout the experiment. EXPECTED OUTCOME: This study will provide much needed information about how reef-building corals react to climate change and ocean acidification, as well as their scope for adaptation and behavioral acclimatization via feeding. The results will inform policy decisions about appropriate CO2 emissions targets and mitigation strategies. They will also inform decisions by local managers striving to maximize coral reef resilience in times of global change. Resilient reefs will be the most likely to survive environmental pressures, maintain productive fisheries, and provide other benefits.
Progress	
Summary	

Program	HI
Project Title	Impact of Land-Ocean Interactions and Ocean Acidefication of C-system Parameters and CO2 Exchange on Reefs of Oahu, Hawaii
Investigators	
Partner	
Description	RATIONALE: Anthropogenic emissions of CO2 and partial uptake of this CO2 by the oceans are expected to continue to lower seawater pH and decrease calcium carbonate saturation state, Ω. These conditions will threaten marine organisms generating calcium carbonate (CaCO3) in a variety of ways that remain poorly understood. Computer simulations suggest a future corrosive environment where dissolution of existing carbonate sediments will exceed production and corals will have difficulty accreting at current rates. Much of the research to date on OA has focused on

	the open-ocean and "model" environments that currently reflect expected future conditions. In particular, in-situ studies of OA, calcification and carbonate mineral dissolution remain sparse in reef environments or have not applied the tools needed to elucidate how ecosystems respond to this threat. The understudied tropical estuaries and coral reefs represent a significant fraction of the global system and play a critical role in the global C cycle. Because the impact of coastal processes on CO2 exchange between ocean and atmosphere remains inadequately characterized worldwide or even in Hawaii, and because time series data are critical to quantify contributions of reefs to air-sea exchange of CO2, it is logical to expand our study to additional sites in concert with the experimental studies proposed in the companion proposal by Guidry et al. GOALS AND OBJECTIVES: To expand our highly successful CRIMP-CO2 project to studies of air-sea exchange of CO2 and carbonate mineral stability in barrier and fringing reef settings. To conduct water and sediment porewater sampling to provide a detailed evaluation of calcification and dissolution. We will develop a detailed understanding of how benthic and water column productivity and calcification/dissolution control the exchange of CO2 between the reefs and the atmosphere. We will also evaluate how seasonal variations impact annually averaged CO2 and O2 gas exchange fluxes and hence the potential for localized OA. METHODOLOGY: We will collect high temporal frequency data for biogeochemically relevant parameters at two CRIMP-CO2 buoys and two HIOOS buoys. Their locations differ in a variety of ways that will allow us to constrain the variability of C-system parameters as a function of biological processes and physical forcing. We will also measure water column currents to better evaluate interactions between air/water/sediments and determine the variability of C-system parameters at these locations. We will follow protocols used in our ongoing study and related NSF research and work in close collaboration with our colleagues at PMEL. This work will be coordinated with the experimental studies of carbonate mineral dissolution by Guidry et al. PROGRESS: Our new research phase in 2008 built upon the successful approach employed in earlier work. High-frequency time-series at multiple sites helped established critical understandings how physical processes act upon biological productivity, calcification/carbonate mineral dissolution, and air-sea exchange of CO2. This work resulted in three MS graduates and five journal articles and 12 conference presentations. Our work has shown Kaneohe Bay is net annual sources of CO2 to the atmosphere, but the strength of the signal is seasonal. EXPECTED OUTCOME: Our work will quantify the direction and magnitude of the air-sea exchange of CO2 in different coral reef settings representative of a substantial portion of the subtropical coastal ocean. It will also quantify calcification and carbonate dissolution in the water column and sediments of coral reef ecosystems, and provide improved understanding of these processes under representative in situ conditions necessary to develop both regional and global estimates of their magnitude.
Progress	Relevance: Anthropogenic emissions of CO2 and partial uptake of this CO2 by the oceans are expected to continue to lower seawater pH and decrease calcium carbonate saturation state. These conditions will threaten marine organisms generating calcium carbonate (CaCO3) in a variety of ways that remain poorly understood. Computer simulations suggest a future corrosive environment where dissolution of existing carbonate sediments will exceed production and corals will have difficulty accreting at current rates. Response: To continue ongoing research to quantify the direction and magnitude of the air-sea exchange of CO2 in different coral reef settings representative of a substantial portion of

	the subtropical coastal ocean; quantify calcification and carbonate dissolution in the water column and sediments of coral reef ecosystems; and provide improved understanding of these processes under representative in situ conditions necessary to develop both regional and global estimates of their magnitude. Results: Establishment of the longest (7 years) continuous CO_2 record in coral reef environments. Determination of annualized gas exchange fluxes at four different locations within the Oahu coral reef system. Determination of first pore-water profiles of CO_2 system parameters in carbonate sediments associated with continuous (CRIMP) water column monitoring stations. Invitation to and provision of advice at several workshops (NOAA-CROAMP program, and Academia Sinica Ocean Acification program)
Summary	Much of the research to date on OA has focused on the open-ocean and "model" environments that currently reflect expected future conditions. In particular, in-situ studies of OA, calcification and carbonate mineral dissolution remain sparse in reef enviro

Program	HI
Project Title	Impact of Land-Ocean Interactions and Ocean Acidefication of C-system Parameters and CO_2 Exchange on Reefs of Oahu, Hawaii
Investigators	
Partner	
Description	RATIONALE: Anthropogenic emissions of CO_2 and partial uptake of this CO_2 by the oceans are expected to continue to lower seawater pH and decrease calcium carbonate saturation state, Ω. These conditions will threaten marine organisms generating calcium carbonate ($CaCO_3$) in a variety of ways that remain poorly understood. Computer simulations suggest a future corrosive environment where dissolution of existing carbonate sediments will exceed production and corals will have difficulty accreting at current rates. Much of the research to date on OA has focused on the open-ocean and "model" environments that currently reflect expected future conditions. In particular, in-situ studies of OA, calcification and carbonate mineral dissolution remain sparse in reef environments or have not applied the tools needed to elucidate how ecosystems respond to this threat. The understudied tropical estuaries and coral reefs represent a significant fraction of the global system and play a critical role in the global C cycle. Because the impact of coastal processes on CO_2 exchange between ocean and atmosphere remains inadequately characterized worldwide or even in Hawaii, and because time series data are critical to quantify contributions of reefs to air-sea exchange of CO_2,

	it is logical to expand our study to additional sites in concert with the experimental studies proposed in the companion proposal by Guidry et al. GOALS AND OBJECTIVES: To expand our highly successful CRIMP-CO2 project to studies of air-sea exchange of CO2 and carbonate mineral stability in barrier and fringing reef settings. To conduct water and sediment porewater sampling to provide a detailed evaluation of calcification and dissolution. We will develop a detailed understanding of how benthic and water column productivity and calcification/dissolution control the exchange of CO2 between the reefs and the atmosphere. We will also evaluate how seasonal variations impact annually averaged CO2 and O2 gas exchange fluxes and hence the potential for localized OA. METHODOLOGY: We will collect high temporal frequency data for biogeochemically relevant parameters at two CRIMP-CO2 buoys and two HIOOS buoys. Their locations differ in a variety of ways that will allow us to constrain the variability of C-system parameters as a function of biological processes and physical forcing. We will also measure water column currents to better evaluate interactions between air/water/sediments and determine the variability of C-system parameters at these locations. We will follow protocols used in our ongoing study and related NSF research and work in close collaboration with our colleagues at PMEL. This work will be coordinated with the experimental studies of carbonate mineral dissolution by Guidry et al. PROGRESS: Our new research phase in 2008 built upon the successful approach employed in earlier work. High-frequency time-series at multiple sites helped established critical understandings how physical processes act upon biological productivity, calcification/carbonate mineral dissolution, and air-sea exchange of CO2. This work resulted in three MS graduates and five journal articles and 12 conference presentations. Our work has shown Kaneohe Bay is net annual sources of CO2 to the atmosphere, but the strength of the signal is seasonal. EXPECTED OUTCOME: Our work will quantify the direction and magnitude of the air-sea exchange of CO2 in different coral reef settings representative of a substantial portion of the subtropical coastal ocean. It will also quantify calcification and carbonate dissolution in the water column and sediments of coral reef ecosystems, and provide improved understanding of these processes under representative in situ conditions necessary to develop both regional and global estimates of their magnitude.
Progress	Relevance: Anthropogenic emissions of CO2 and partial uptake of this CO2 by the oceans are expected to continue to lower seawater pH and decrease calcium carbonate saturation state. These conditions will threaten marine organisms generating calcium carbonate (CaCO3) in a variety of ways that remain poorly understood. Computer simulations suggest a future corrosive environment where dissolution of existing carbonate sediments will exceed production and corals will have difficulty accreting at current rates. Response: To continue ongoing research to quantify the direction and magnitude of the air-sea exchange of CO2 in different coral reef settings representative of a substantial portion of the subtropical coastal ocean; quantify calcification and carbonate dissolution in the water column and sediments of coral reef ecosystems; and provide improved understanding of these processes under representative in situ conditions necessary to develop both regional and global estimates of their magnitude. Results: This work now represents the longest standing record of continuous automated CO2 measurements in the coastal ocean and in tropical coral reefs. The Kaneohe Bay buoys are being incorporated into the NOAA Coral Reef Monitoring Assets (CROAMP) as Class III (Sentinel) sites.

Summary	Much of the research to date on OA has focused on the open-ocean and "model" environments that currently reflect expected future conditions. In particular, in-situ studies of OA, calcification and carbonate mineral dissolution remain sparse in reef enviro

Program	LA
Project Title	Adapting to Climate Change through the Integration of Land Use Planning and Hazard Mitigation in Coastal Communities: Lafourche Parish, LA and Abbeville, LA
Investigators	Daigle, M. (Louisiana Sea Grant); Wilkins, J. (Louisiana Sea Grant);
Partner	Lafourche Parish, LA; Louisiana State University, AgCenter (LSU); Vermilion Parish, LA;
Description	Objectives The focus of this project is to strengthen parish and local leadership in Lafourche Parish, Louisiana, and Abbeville, Louisiana, as the both face adaptation to climate change. The PIs will provide technical assistance and guidance to local officials on how to best implement sea level rise into their planning process. The PIs will also prepare and distribute educational materials in a variety of formats concerning climate change and adaptation tools. Methodology The PIs will coordinate with local government leaders, city and parish agencies, and community organizations through onsite meetings and workshops. The PIs will provide information and written materials to their constituents, as well as provide community members with access to recorded presentations. The PIs will work with various groups, such as the Southern Climate Impacts Planning Program, and local marine extension agents. Rationale The PIs will target two communities with the project, one each year of the project. The first community targeted will be Lafourche Parish, Louisiana. Areas of the parish are very low, and the risk of flooding will only increase with climate change. Port Fourchon, located at the southern portion of the parish, supports 18% of the nation's energy needs and is a vital asset to national energy security. The second community will be Abbeville, Louisiana. Abbeville is located in Vermillion Parish. The city prides itself on its closeness to the coast and its community priorities, including family, faith, and friends. A long-term plan incorporating climate change in decision-making will allow Lafourche and Abbeville to grow sustainably and resiliently.
Progress	
Summary	

Program	LA
Project Title	Vulnerability and Resilience in Threatened Coastal Louisiana Communities
Investigators	Blanchard, T. (Louisiana State University (LSU)); Carney, J. (Louisiana State University (LSU)); Goidel, K. (Louisiana State University (LSU)); Lee, M. (Louisiana State University (LSU)); Slack, T. (Louisiana State University (LSU));
Partner	Lafourche Parish, LA; Louisiana Governor's Office of Coastal Protection and Restoration; Terrebonne Parish, LA;
Description	Objectives The objectives in year one of this project are 1. Perform a household survey across an ecological transect containing numerous coastal Louisiana communities to better understand variations in household attitudes and resources related to adaptation to coastal erosion. 2. Link survey data to newly released American Community Survey collected by the U.S. Census Bureau to understand how attitudes towards and ability to adapt to coastal erosion are conditioned by differential community characteristics (aggregate vulnerability and resilience). 3. Construct measures of cross community connectedness based on the social network module and examine how ties to geographically external communities relate to preparedness, vulnerability, resilience, and prospects for sustainability. Methodology Our objectives involve the analysis of two main data sources: 1) household survey data drawn from a transect of Louisiana coastal residents, and 2) American Community Survey data collected by the U.S. Census Bureau. To survey Louisiana coastal residents, we will partner with the LSU Public Policy Research Laboratory (PPRL) to conduct a household telephone survey. We will use Terrebone and LaFourche parishes as an ecological transect which contains a diverse set of coastal communities. Our survey instrument will include measures that capture key themes identified in the sections above on vulnerability and resilience, preparedness, connectedness to the environment, and so forth. We will also obtain feedback from initial drafts of our survey instrument from key stakeholder in state government as well as local Sea Grant extension agents. Our survey will provide information on attitudes towards key themes related to coastal erosion and relocation. We will also include questions that provide information on the resources available to households, such as social networks, employment status, and linkages to resource based industries, such as fisheries and the oil and gas industry. We also intend to link data from the ACS to our survey data. The ACS provides detailed socioeconomic data derived from an annual sample of approximately 4.5 million U.S. residents. The data provide information on key issues such as poverty, employment, income, commuting patterns, migration, and family composition. The ACS replaces the long form version of the Census used in prior Census years. Currently, the U.S. Census Bureau has released data on zip code areas, and neighborhoods based on data collected between 2006 and 2010. These

	data will allow us to develop our measures of socioeconomic vulnerability and community resilience and link these data to our household survey data. Rationale The rationale for this approach is that the survey data will highlight community level variations in vulnerability and resilience to sea level rise, coastal erosion, salt water intrusion and natural and technological disasters. The summary community level census data can be linked with the individual respondents data by community of origin, and we can then examine how both community level and individual level factors relate to individual perceptions of community preparedness.
Progress	
Summary	

Program	LC
Project Title	ADAPTING TO CLIMATE CHANGE WITH LOW IMPACT DEVELOPMENT STORMWATER MANAGEMENT IN THE LAKE CHAMPLAIN BASIN
Investigators	Carol Adair (University of Vermont (UVM)); Stephanie Hurley (University of Vermont (UVM));
Partner	
Description	This project will explore the resiliency of Low Impact Development (LID) stormwater bioretention systems in the context of mitigating existing and projected future urban runoff stressors that impact Lake Champlain. An existing landscaped area will be retrofitted to create a set of ten bioretention cells of approximately identical size and slope that demonstrate different soil and vegetation design variables (a total of ten cells/areas). Over the course of an 18-month study, the response of the systems to current "natural" and simulated climate-change-driven hydrologic patterns will be observed. The effects of existing conditions and projected future conditions on the soils and vegetation within each bioretention system will be compared and each system's hydrologic performance, sediment, phosphorus and nitrogen retention, and greenhouse gas (CO_2, N_2O and CH_4) emissions will be evaluted. This will allow recommendations to be made regarding the attributes of bioretention systems that are the most resilient, robust, flexible, and ultimately sustainable for use in urban areas in the Lake Champlain Basin.
Progress	Our first major accomplishment in the first year of the project included advertising for, interviewing, and accepting a graduate student, Amanda Cording, to work on this project. During the course of this process, and observing Ms.

	Cording's clear talent and preparedness to take on the project, we revised our proposal's request for a master's student and determined our project data would be the fodder for a PhD dissertation. Our second major accomplishment was a multi-phase process of designing and re-designing our outdoor laboratory on the UVM campus, applying for the appropriate permits, developing a Request for Proposals and soliciting bids from contractors, and ultimately selecting a contractor (EcoSolutions of Burlington, Vermont) and constructing the project in the fall. The largest obstacle was the timeline of the University in their approvals of the construction plans; it was essentially overcome by constructing the project in the fall instead of in the summer. There were also substantial utility conflicts that were not on the "As Built" plans and therefore two of the cells were not able to be constructed and the cell depths had to be changed from 4' to 3'. Various details in the projects design also required necessary re-design, including the design of the inflow and outflow monitoring devices on the cells.
Summary	

Program	MD
Project Title	Phragmites australis invasion in the Chesapeake Bay: Implications of nitrogen pollution, elevated CO2 and genotypic variation for tidal marsh management
Investigators	Melissa McCormick (Environmental Research Center, Smithsonian Institution (SI)); Patrick Megonigal (Environmental Research Center, Smithsonian Institution (SI)); Thomas Mozdzer (Environmental Research Center, Smithsonian Institution (SI));
Partner	University of Maryland (UMD);
Description	OBJECTIVES: Our goal is to forecast how Phragmites invasion rates will respond to two fundamental global change factors, elevated CO2 and N pollution. The results of our work will be directly applicable to land managers currently dealing with Phragmites invasion and the resulting displacement of native plant communities. We expect the proposed research to generate clear insights about how Phragmites invasions will respond in the future to elevated CO2, N pollution, and sea level rise, the consequences of such invasions for key tidal wetland ecosystem services, and insights into controlling Phragmites invasion in the future. METHODOLOGY: In an ecosystem-level field experiment, we will expose both Phragmites and the native plant community it is invading to predicted changes in CO2 and N, thereby simulating present and future environmental conditions. Elevated CO2 will be achieved with open top chambers (OTC). Plant communities will be assigned to four treatments: (1) ambient CO2, (2) ambient CO2+N (+25 g N m-2 yr-1), (3)

	elevated CO2 (ambient+340 ppm), and (4) elevated CO2 + N (n=3 per treatment). A novel feature of the study is that the chambers are designed to measure the rate of Phragmites invasion into native marsh as the primary response variable. To evaluate ecosystem level responses, we will measure invasion progress, genotypic diversity, ecophysiological responses, and nutrient availability. Surface Elevation Tables (SETs) will provide soil elevation data. RATIONALE: Our preliminary greenhouse data demonstrate that Phragmites growth will likely increase with rising concentrations of CO2 and N. However, it is unclear whether enhanced Phragmites growth or the invasion process will be affected in real, intact marsh ecosystems field where elevated CO2 has been demonstrated to decrease N availability. Thus, in the field, elevated CO2 may actually help limit future invasions driven by N eutrophication. In addition, intraspecific genetic diversity that increase niche breadth may further increase the probability and/or rate of invasion. Our work is highly relevant to the Chesapeake Bay where Phragmites invasions threaten to alter carbon and energy exports to the estuary, and alter habitat for aquatic species of significant economic interest. Given our preliminary data, there is hope that if N loading can be limited, it may be possible to limit future invasions in Chesapeake Bay, especially in combination with elevated CO2.
Progress	RELEVANCE: In the Chesapeake Bay, invasions of the wetland plant Phragmites australis (the common reed) threaten to alter both carbon and energy flows as well as habitat for aquatic species of significant economic interest. Through field studies, this new project seeks to forecast how Phragmites invasion rates will respond to elevated carbon dioxide and nitrogen pollution. The researchers grew Phragmites in specialized chambers under controlled conditions. Based on previous research in the greenhouse, the team hypothesized that Phragmites growth would increase with rising concentrations of carbon dioxide and nitrogen. However, it has been unclear whether enhanced Phragmites growth or the invasion process will be affected in real, intact marsh ecosystems where elevated carbon dioxide has been demonstrated to decrease nitrogen availability. RESPONSE: The principal investigators are Patrick Megonigal, Thomas Mozdzer and Melissa McCormick, all of the Smithsonian Environmental Research Center. In this ecosystem-level field experiment, the researchers have exposed both Phragmites and the native plant community to future predicted atmospheric levels of carbon dioxide (CO2) and nitrogen (N). They assigned plant communities to four treatments: (1) ambient CO2, (2) ambient CO2 + N, (3) elevated CO2, and (4) elevated CO2 + N. To evaluate ecosystem level responses, they are measuring invasion progress, genetic diversity, physiological responses, and nutrient availability. RESULTS: The researchers' preliminary analysis of the data on Phragmites density (a proxy for expansion rate) shows that nitrogen pollution stimulated Phragmites invasion rates over the past two years. Elevated carbon dioxide also increased rates of invasion, but the effect was marginal, perhaps due to nitrogen limitation, as the researchers had predicted. The interaction between carbon dioxide and nitrogen significantly increased Phragmites density, suggesting that nitrogen pollution will increase expansion beyond the rates of invasion observed today. That may make P. australis more capable of displacing additional marsh habitat; in that case, marshes will also become less vulnerable to salt-water intrusion because of an increased capacity to rise in elevation.
Summary	Data from field experiments suggests that increases in carbon dioxide and nitrogen will increase Phragmites invasions,

	while carbon dioxide alone has a weak stimulatory effect on Phragmites expansion. Preliminary data suggest that altering land management

Program	MD
Project Title	Forecasting Watershed Loading and Lagoon Response Along the Delmarva Peninsula due to Changing Landuse and Climate
Investigators	Iris Anderson (Virginia Institute of Marine Science (VIMS)); Joanna York (University of Delaware (UDEL)); Kevin Kroeger (US Geological Survey (US DOI, USGS)); Lora Harris (University of Maryland, Chesapeake Biological Laboratory (UMD)); Mark Brush (Virginia Institute of Marine Science (VIMS)); Walter Boynton (University of Maryland, Chesapeake Biological Laboratory (UMD));
Partner	
Description	OBJECTIVES: We propose a multidisciplinary modeling and field program to calibrate and apply watershed and lagoon ecosystem models across the seaside of the Delmarva Peninsula. Watershed modeling will be accomplished through a simplified Nitrogen Loading Model (NLM) calibrated through existing estimates of loads and new measurements of groundwater nutrients and source tracking. The NLM will then be used to predict changes in nitrogen loads to the Delmarva lagoons as a function of changes in landuse, population sizes, and agricultural activities across the landscape. Forecasted loads will feed into a novel lagoon ecosystem model at two scales: (1) a coarse-scale version applied across all Delmarva lagoons and (2) a fine-scale version applied within specific lagoons. These models will be used to predict lagoon response to changing watershed loads and climate with a focus on (1) water quality, (2) habitat and ecosystem services, (3) alternative stable states, and (4) non-linear recovery trajectories. METHODOLOGY: This work leverages our Sea Grant regional demonstration project currently under completion which has resulted in initial application of the NLM across the Delmarva and both the coarse- and fine-scale lagoon models in selected systems. Research will focus on simulations to predict changes in watershed loads and lagoon response. Field studies will provide data to improve calibration in two areas: (1) tidal creek water quality in VA to complement MD and DE datasets, and (2) groundwater nutrient sampling and source tracking. RATIONALE: Local and county-wide managers on the Delmarva are currently faced with decisions related to landuse, development pressure, agricultural operations, and population growth, but presently there is limited information relating watershed activities to resulting nutrient loads and lagoon responses. Management targets for landuse decisions and nutrient loading along with decision-support modeling tools are urgently needed in these systems.

Progress	RELEVANCE: Local and countywide managers on the Delmarva peninsula currently face important decisions related to land use, development pressure, agricultural operations, and population growth. At the same time, there is little information relating activities in the watershed to resulting nutrient loads and responses of coastal lagoons. A multidisciplinary modeling and field program is needed to help identify management targets for land-use decisions and nutrient loading. RESPONSE: The principal investigators of this ongoing project are Lora Harris and Walter Boynton of the University of Maryland Center for Environmental Science Chesapeake Biological Laboratory and Mark Brush and Iris Anderson of the Virginia Institute of Marine Science. This work leverages their Sea Grant regional demonstration project, which resulted in the initial application of a nitrogen loading model (NLM) across the Delmarva Peninsula and a lagoon model in selected systems. The researchers have calibrated the NLM through existing estimates of loads and new measurements of groundwater nutrients and source tracking. The NLM can be used to predict changes in nitrogen loads to the Delmarva lagoons as a function of changes in land use, population sizes, and agricultural activities across the landscape. RESULTS: The project underscored the importance of modeling the effects of increasing water temperatures that are predicted to result from future climate change in order to model accurately the growth of submerged aquatic vegetation under different levels of nutrient loading. Although this research focused on seaside coastal lagoons of the Delmarva Peninsula, the results are applicable to efforts to restore SAV in the Chesapeake Bay, and the researchers have shared their findings with the Chesapeake Bay Program's Submerged Aquatic Vegetation Work Group as it prepared a new strategy document for SAV restoration. The researchers are helping to plan a workshop with natural-resource managers across the Delmarva Peninsula to share the model and discuss its use in management.
Summary	Work is underway to connect a nitrogen loading model (NLM) to an ecosystem model for the Delmarva Peninsula. Using data gleaned from fieldwork and model simulations, researchers on this ongoing project are working to predict changes in watershed nitrogen

Program	MD
Project Title	Do Spring Plankton Blooms Enhance Methane Flux from the Sediments of the Chesapeake Bay
Investigators	Laura Lapham (University of Maryland, Center for Environmental Science (UMD));
Partner	
Description	Do Spring Plankton Blooms Enhance Methane Flux from the Sediments of Chesapeake Bay. Project to investigate the

	amount of methane in the Bay and determine if it is getting out of the sediments. Methane is a powerful greenhouse gas, and could be seeping out of the sediments. Yet estuarine flux of methane to the atmosphere has not been taken into account in the global methane budget. Also, increased hypoxia in the bay may also stimulate methane release from sediments.
Progress	
Summary	

Program	ME
Project Title	Enhancing Sea Grant's Ability to Help Coastal Communities Adapt to Climate Change
Investigators	Esperanza Stancioff (Maine Cooperative Extension Service); Kristen Grant (Maine Sea Grant);
Partner	Maine Coastal Program, State Planning Office; Maine Cooperative Extension Service; Normandeau Associates; Woods Hole Oceanographic Institution Sea Grant (WHOI);
Description	
Progress	RELEVANCE: Coastal property owners and municipal officials lack access to accurate information on options for and the effectiveness of climate change adaptation strategies in Maine. RESPONSE: Maine Sea Grant created a series of outreach materials (seagrant.umaine.edu/program/sarp and seagrant.umaine.edu/coastal-hazards-guide) and helped form the state's first professional Climate Adaption Providers' Network. RESULTS: The State of Maine has incorporated Maine Sea Grant's resources into the Basic Land Use, Shoreland Zoning, and Floodplain Management trainings for local Code Enforcement Officers. Additionally, 30 professionals have joined the Climate Change Adaptation Providers' Network and the group is identifying a strategy for coordinating services for climate adaptation implementation in a pilot community.
Summary	Maine Sea Grant's climate adaptation resources have been integrated into the state's Code Enforcement Officer trainings and informed creation of the state's first professional Climate Adaption Providers Network.

Program	ME
Project Title	Sea Grant Climate Adaptation 2011: City of Ellsworth, ME – Coastal Infrastructure Resiliency in a Changing Climate
Investigators	Joyce (Esperanza) Stancioff (University of Maine Cooperative Extension (UMaine)); Kristen Grant (Maine Sea Grant); Shaleen Jain (University of Maine, Orono (UMO));
Partner	City of Ellsworth, ME; Hancock County, ME Emergency Management Team; Maine Department of Environmental Protection (ME DEP); Maine Department of Transportation (ME DOT); Maine Sea Grant; NOAA Sector Applications Research Program (US DOC, NOAA, OAR, CPO, SA
Description	(22) OBJECTIVES: Goal: The City of Ellsworth Maine will effectively prepare for, respond to, and reduce impacts from future stormwater and flooding. Objectives Work collaboratively with the City of Ellsworth, ME to: 1.develop a community based adaptation model to address management protocols for stormwater and flood protection infrastructure. 2.develop a network decision- making map and decision calendar to direct local governance processes in the face of coastal hazards. (23) METHODOLOGY: The project team (including federal, state, regional, local decision makers, and project staff) will contribute to the development of a network decision-making map (local, regional, state and federal decision makers involved in the maintenance, repair, replacement, and financing of culverts), as well as the compilation of scientific and engineering information needed to assess the adequacy of culvert design, quantification of flood risk for a select set of culverts on multiple time horizons. Project staff then drafts Integration of hydrologic design modeling with data and information system for the City of Ellsworth, including downscaled extreme precipitation scenarios based on the Intergovernmental Panel on Climate Change's A1B emissions scenarios for the 21st century. The Project team then analyzes the feasibility of climate adaptation options related to stormwater and flood-protection infrastructure. Next, project staff conduct geospatial mapping of the climate related risk premised on recent extreme precipitation and future scenarios with existing infrastructure (small watershed modeling, coupled with culvert size assessment). Maps will then be developed, by the Project Team, showing climate-related risk, based on multiple decision criteria (flooding, economic costs, future development scenarios, and potential for flood-related disruption). Project staff next develop a draft working group protocol for information sharing and coordination, which includes, however, is not limited to the City of Ellsworth, State DOT, Inland Fish and Wildlife, and USDA NRCS. Project staff then develops draft schematic of network decision-maker map and decision calendar, which is finalized by the Project team. Project team plans and hosts a community meeting to present findings and show tools to be utilized and incorporated into Ellsworth Comprehensive Plan and Mitigation Plan and the project evaluation implemented. (24) RATIONALE: Adaptation in a changing climate is an urgent priority for coastal communities. Maine's coastal communities represent an excellent laboratory to investigate adaptation strategies that mobilize science-based approach with a clear

	appreciation of local contexts, governance, and information needs. Individual extreme events, such as Summer 2009, exemplify the widespread societal and economic impacts on Maine's coastal communities. The Maine Healthy Beaches Program, which monitors coastal water quality, experienced 250 beach advisories or closures due to rain events. This greatly impacts tourism, which is the largest industry in Maine. Municipal infrastructure and coastal ecosystem function are compromised with such extreme events, as was also demonstrated by the 2005 Patriot's Day Storm which flooded many areas in southern Maine and a more recent landslide from a bluff area in Stockton Springs. Extreme meteorological events, sea-level rise, ageing infrastructure, and increasing concentration of development along the coast reinforce the notion that transferable models of management, planning, and governance at community-level are needed to improve responsiveness and anticipate investments and resource allocation. Based on a 2008 estimate, Maine's coastal zone counties account for 77% of the statewide jobs in the industrial sector, and 81% of the jobs in the leisure and hospitality sector. Consequently, new approaches that increase resiliency to climate and coastal hazards will lead to benefits for coastal communities and the economic sector. Results from our previous work with town and city officials affirm the needs to mitigate the recurrent impacts from extreme rain events—planning and decision-making related to maintenance, repair, replacement of stormwater infrastructure, including culverts are viewed as a major issues.
Progress	
Summary	

Program	MI
Project Title	Integrated Assessment of Torch Lake Area of Concern
Investigators	Carol MacLennan (Michigan Technological University (MTU)); Judith Perlinger (Michigan Technological University (MTU)); Noel Urban (Michigan Technological University (MTU));
Partner	
Description	Objectives: The goals of this Integrated Assessment (IA) have been specifically aligned with Sea Grant's national and state strategic plans. These goals are (1) to collect and to summarize information on the historical development and current status of the AOC (Goal 1 in National Sea Grant strategic plan, Goal A in state strategic plan); (2) to inform

stakeholders of the current status of the site and the BUI's in a manner that will be understandable to the general public (national goal w, sate Goal B); (3) to present to and solicit from stakeholders potential solutions that could lead to removal of BUI's and delisting of this site as an AOC (national goal 3, state goal C); (4) to assemble existing data to evaluate these potential solutions (national goals 1 and 3, state goal A); and (5) to identify the key holes in existing information that prevent a more rigorous evaluation of policy options (national goal 3, state goal C). The project has been planned and will be executed in close conjunction with the state agency (MDEQ) responsible for making and implementing policy at the site; hopefully, the project will facilitate new actions or policies on the part of the MDEQ that will lead to site delisting. Methodology: To accomplish the goals above, this project will have three components: 1) gathering and summarizing existing information; 2) Interactions with stakeholders; and 3) Evaluation of future options. For project component 1, this project will compile existing information and will search previously under-utilized data sources in order to document the status and trends in conditions at this AOC as well as the causes for these conditions. Studies conducted at this site since the late 1800's are spread among mining company records and reports; unpublished university reports; government agency reports (primary the MDEQ, MDNR and the US EPA); publications in the scientific, cultural, economics, and mining literature; and graduate dissertations from at least four universities. With regards to the historical research on contaminants in Torch Lake from mine facilities (required to address the BUI of fish advisories), there are two invaluable but hitherto under-utilized resources that will be used in this work, viz, the historical archives at Michigan Technological University (MTU) and the memories of residents in the area. A key component will be providing maps of historical industrial activity (to be gleaned from review of the historical archive at the MTU library and from oral interviews) together with maps showing sites of industrial contaminant removal or measurement performed by the state and the EPA. Juxtaposition of these maps is expected to be particularly helpful in identifying likely locations of industrial contaminants that are responsible for the fish advisories. Oral histories will be especially helpful in clarifying contradictory and missing information from available maps. The three objectives of our stakeholder interactions are: a) to enhance and expand the group of stakeholders aware of the status of the AOC and having an input into future actions; b) to inform stakeholders of the current status of the AOC; and c) to solicit from stakeholders ideas and preferences for remediation alternatives that would lead to removal of BUIs and delisting as an AOC. To   Rationale: Intensive copper mining occurred on the Keweenaw Peninsula from 1845 through 1968. Between 1868 and 1968 approximately 180 million metric tons of stamp sands were discharged by six large-volume stamp mills (Hecla, Calumet, Tamarack, Osceola, Quincy #2, Quincy #3) along the western shoreline (towns of Lake Linden, Hubbell, Tamarack and Mason) into Torch Lake. Between 1915-1967, 3 mills chemically reprocessed dredged tailings (Calumet and Hecla, Tamarack, Quincy; copper reclamation, ammonia leaching technique) (Benedict 1955; Lopez and Lee 1977), recycling an additional 61 million metric tons of tailings (Kerfoot et al. 1994; US EPA 2001). Torch Lake alone received over half of the total stamp sand tailings discharged onto the entire Keweenaw Peninsula; approximately 20% of the original lake volume was filled with tailings. The coarse fraction of the "stamp sands" remained along the western shoreline as beach sand and gravel piles, whereas the clay-sized fraction (7-17% by mass) created during the milling

	process, the "slime clay" fraction (Lankton and Hyde 1982), dispersed out into the deep basins (Kerfoot and Robbins 1999). After milling operations ceased (1968), an additional discharge of 27,000 gallons of cupric ammonium carbonate took place in 1972 from a leaching plant (Lopez and Lee 1977). The mining-related degradation of the lake led ultimately to the designation of Torch Lake as an Area of Concern (AOC). In the 1970's tumors were observed on fish caught in Torch Lake. This led to the imposition of a fish consumption advisory that ultimately led to the placement of Torch Lake on the National Priority List (NPL) as a Superfund site in 1984. Because Torch Lake has a direct hydrologic connection with Lake Superior, the site was included on the original list of 42 AOCs in 1987. The Torch Lake AOC includes just those portions (4 of a total of 14) of the Torch Lake Superfund locations that impinge directly upon Torch Lake; only contamination arising within the watershed is eligible to be treated. The site underwent the prescribed activities for both the AOC and Superfund programs. The Torch Lake AOC Remedial Action Plan (RAP) was drafted by the State of Dept. of Natural Resources (DNR) in 1987. The Torch Lake Superfund site underwent a progression of activities intended to remediate the site and to remove it from the NPL. A baseline study by the EPA led to the promulgation of the Record of Decision published in 1992 and 1994. A Public Advisory Council (PAC) was formed in 1997. The EPA completed their baseline study with recommendations for remediation in 2002. The AOC RAP was updated in 2006. Superfund remedial actions were implemented between 2002 and 2006, and portions of the site have been deleted from the NPL. The PAC has also requested that the State begin the procedure to delist Torch Lake as an Area of Concern. The "wicked" nature of the problem is not readily apparent in the historical chain of events described above. In reality, the problem is much more "wicked". In reality, the remediation has not worked. The primary components of the EPA's remediation involved capping of exposed stamp sands and "nature attenuation" for contamination in the lake itself. Capping of the stamp sands was intended to reduce human and wildlife exposure to metal contaminants in the stamp sands, and to prevent erosion of the stamp sands into the lake. However, the vegetation on the cap has died back to the point where the cap is now eroding (Baker 2007). If this erosion is not checked, the stamp sands will continue to be uncovered, and the documented gains in wildlife habitat reversed. The selection of "natural attenuation" for the lake was based on the assumption that adequate inputs to the lake of uncontaminated sediments would occur such that the contaminated sediments would become buried over time (Fig. 1), and the fresh, uncontaminated sediments would become colonized by benthic organisms. Evaluation of the rate of sedimentation in the lake reveals, however, that this natural detoxification would require hundreds of years because the copper is diffusing upwards from the zone of contamination at least as fast as fresh sediments are accumulating at the sediment surface (Mcdonald et al. 2009). Hence, the remediation that has been performed is unlikely to remove the BUI of degradation of the benthos. Systematic efforts to locate and remove sources of industrial PCB contamination that contribute to the BUI of fish consumption advisories have been limited in scope and have not removed all local sources of contamination.
Progress	
Summary	

Program	MIT
Project Title	Development of an Inundation Forecast System for Massachusetts Coastal Waters
Investigators	Changsheng Chen (University of Massachusetts, Dartmouth); Robert C Beardsley (Woods Hole Oceanographic Institution (WHOI));
Partner	
Description	Objectives : In the last four years, we have established the Northeast Coastal Ocean Forecast System (NECOFS) (http://fvcom.smast.umassd.edu/research_projects/NECOFS/index.html). Developed using FVCOM and other existing models, NECOFS was placed in operation in late 2007. This system was originally set up for the New England Shelf, Georges Bank, Gulf of Maine, and Scotian Shelf region. In 2010, a subgrid nested domain FVCOM model for Massachusetts's coastal waters (horizontal resolution varying from 10 m in estuaries to 1 km over the inner shelf) and a regional surface wave model were added to NECOFS and put into operation. Built on the NECOFS framework, we have setup a sub-domain FVCOM inundation model for Scituate as a pilot study to test the capability of NECOFS for "end-to-end" inundation forecasting. This inundation model has been validated for selected extratropical storms (Noreasters) of 2005, 2007 and 2010. Built on our accomplishment in developing an inundation model for Scituate, we propose to extend this inundation model domain to cover the entire Massachusetts coast and establish an inundation forecast model system for the state. This system will be one component of NECOFs and will meet the technical requirements for an end-to-end inundation forecast system with (1) accurate high-resolution water depth (bathymetry) and land elevation (topography) data sets to resolve the study area geometry; (2) a high-resolution unstructured-grid 3-D ocean circulation model with capabilities of accurately resolving complex irregular coastal geometry and flooding/drying process, (3) a high-resolution surface wave model with full shallow-water dynamics that can be coupled with the circulation model; (4) accurate river discharge, tidal forcing, and surface forcing (wind, momentum, heat and moisture fluxes) fields to drive the coupled model system, and (5) hardware and software capable of delivering water level and other predictions in an interpretable and timely manner to end users (especially the NOAA National Weather Service Taunton (MA) Weather Forecast Office and other weather forecasters, town, state, federal emergency management, and the public). This project meets the MIT Sea Grant Implementation Plan 2009-2013 in focus areas of sustainable coastal development and hazard resilience in coastal communities. Methodology : The Massachusetts coastal

	inundation forecast system will be developed as one component of NECOFS and will be placed into 24 (hours)/7 (days) operation. The major outcome of our pilot inundation model validation activities is the success in building the Scituate inundation model system that includes all key components. High-resolution (1-m × 1-m) LIDAR bathymetry/elevation, USGS bathymetry, and state elevation data were used to configure our FVCOM coupled current-wave model. The core FVCOM code includes the 3-D flooding/drying process and ability to couple dynamically with the surface wave model (SWAVE: our unstructured-grid version of SWAN). Unlike most existing inundation models, the FVCOM-based inundation forecast system features a fully 3-D model with temperature and salinity stratification. Thus, a key step to making the inundation forecast is to produce a full marine environmental forecast, which includes surface weather (GoM-WRF) and wave conditions (SWAVE), and ocean state (surface elevation, 3-D currents, temperature/salinity stratification, wave setup, wave-current interaction, bottom stress, etc.). The forecast operation will be made through nesting of the NECOFS regional model and the local inundation model: first running a full regional NECOFS regional grid but without land topography (i.e., without flooding/drying), then using the regional model output to drive with the more localized high-resolution FVCOM grids with land topography to forecast inundation. This two step approach simplifies model system setup, providing for a stable regional model grid while facilitating easy modification/refinement of local land topography (and water bathymetry) model grids and the addition of new areas into the inundation forecast system. Rationale : Coastal inundation, the flooding of normally dry land, in Massachusetts is generally caused by some combination of heavy rains, high river discharge, tides, high winds, wind waves and storm surge. The combined wind waves and storm surge during high tides are dangerous and can cause significant damage in the coastal zone. There is a clear need for a coastal inundation forecast model system for Massachusetts. The desired outcomes of such a system include (1) warning of coastal flooding on an event timescale in order to facilitate evacuation and other emergency measures to protect human life and property in the coastal zone, and (2) accurate estimation of the statistics of coastal inundation in order to enable rationale planning regarding sustainable land-use practices in the coastal zone. The functional requirements for this system are (1) accurate, real-time forecasting of water level at high spatial resolution (order 10 m or less) in the coastal zone, including estimates of uncertainty, and (2) accurate estimates of the statistics of water level (one year, ten year, hundred year, etc.) as a function of position in the coastal zone, including estimates of uncertainty. NECOFS is an operational forecast system that is capable of predicting the physical environment in Massachusetts coastal waters. Implementing an inundation model component into NECOFS meets the goal of the MIT Sea Grant strategic plan in providing the research, engineering and management community with an essential tool for environmental prediction, ecosystem-based resource management, and many other important applications related to Sea Grant's mission.
Progress	The most important immediate outcome of this project is to establish a statewide inundation forecast system for Massachusetts. End users include Northeast Weather Station Weather Forecast Offices (NWS WFO) and other weather forecasters, emergency management planners and managers, policy-makers and land-use planners in local, state, and federal government agencies, private industry, and the public. The Northeast Coastal Ocean Forecast System (NECOFS)

	has already been in use by these end-users for several years now, so adding this inundation system will strengthen the application of NECOFS for these users.
Summary	Efforts to establish a statewide inundation forecast system for Massachusetts show promise.

Program	MIT
Project Title	Sea Grant Climate Adaptation Capacity Building Initiative: Engaging Citizen Scientists Through Technology
Investigators	Chyrssostomos Chryssostomidis (Massachusetts Institute of Technology Sea Grant (MIT)); Juliet Simpson (Massachusetts Institute of Technology Sea Grant (MIT));
Partner	
Description	Objectives : To reach out to citizen scientists through technology using a smart phone app to engage stakeholders, assess information needs, and expand Sea Grant's climate change outreach capacity. Methodology : We will create and share a climate change-themed scavenger hunt game smart phone application. Through this game we can engage the public in two-way communication, not only disseminating information but also receiving immediate, real-time feedback on people's perceptions, attitudes, and awareness of coastal hazards and climate change-related issues in their communities. The game will leverage the enormous popularity of smart phones incorporating web access, cameras and GPS devices, to create a large coalition of informed, engaged citizen scientists. The scavenger hunt game will consist of an expandable list of climate and ocean-related items which the user can read information about, either directly through the app or through website links. The user can then identify an item in the real world, photograph it and upload a geotagged image to score points. Once the user community is large enough, all judging and scoring can be accomplished by the community itself (e.g., asking users to give "thumbs up" or "thumbs down" ratings to each other's submissions), creating a scalable, self-sustaining program. For instance, items in the scavenger hunt might include "hardened coastline". Players can initially score points by uploading a photograph of an example of hardened coastline, while higher levels of the game might ask them to distinguish between sea walls, rip rap, groins and jetties, or other structures, identify beneficial or detrimental effects of each, or find examples of alternatives. Similar hunt-type games such as geocaching apps have attracted millions of users worldwide. This game has the potential to reach thousands of participants in Massachusetts alone, and if successful could be easily adapted by other Sea Grant programs and made available to their constitutents nation-wide. Rationale : While there is a great deal of information available to the public

	on climate change and related impacts, much of it is highly complex and offered at an overwhelming level of detail which makes it functionally unavailable. There is a profound need for new methods of (1) disseminating needed information about climate change, its likely impact, and communities' potential for adaptation to those impacts, and (2) understanding the existing knowledge base and attitudes towards climate change impacts in the coastal zone.
Progress	
Summary	

Program	MN
Project Title	Great Lakes Coastal Weather, Water, and Beach Safety Forecasts and Products for Recreational Users and Coastal Residents
Investigators	Jeffrey L. Gunderson (University Of Minnesota (UMN));
Partner	
Description	A half time Great Lakes Coastal Storms Outreach Coordinator will address the following objective. By 2015, recreational audience members (eg. boaters, beach goers, kayakers, surfers, sailors, anglers, etc) and coastal residents will use improved storm forecasts and early warning alerts and systems to improve weather, beach, and water safety and decrease loss of life. In addition, local governments will be better informed of stormwater impacts and mitigation practices. Communities, associations, rescue squads, and other organizations will be engaged to help make these forecast and early warning systems more broadly available.
Progress	RELEVANCE – As the nation prepares for a changing climate, adaptation and mitigation efforts often involve seeking financial support. Sources for this support are available but it can be challenging to identify them. RESPONSE – MNSG staff worked with staff at the NOAA Coastal Services Center to produce an abstract listing of currently available, climate-related funding opportunities (called Climate Funding Opportunities). The list provides a snapshot of available funding opportunities from government, non-profit, philanthropic, and academic organizations throughout the country. The document provides application, funding, and eligibility information on four international funding opportunities, 16 national-scale opportunities, and 12 regionally focused opportunities. This document provides support to organizations that would not otherwise have the ability to expend staff resources to compile information on available funding sources

	for climate adaptation project work. In collaboration with The Nature Conservancy, the document is available through the Collaboratory for Adaptation to Climate Change website (www.adapt.nd.edu). RESULTS – "Climate Funding Opportunities" was posted to the Collaboratory website as a PDF on January 9, 2013, and received 946 hits in 7 days.
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Progress	With the Great Lakes Sea Grant Network, we obtained Great Lakes Restoration Initiative funding to continue ship- and land-based educator professional development throughout the Great Lakes states for the next four years, through a newly-minted program called Center for Great Lakes Literacy (www.cgll.org). Three graduate students (one in environmental education and two in MS programs in the aquatic sciences) and one technician (interested in graduate school in survey design and evaluation) were mentored in internship programs to develop their skills in outreach, lesson development, and evaluation. In cooperation with the Lake Superior NERR Education Coordinator, MNSG sponsored an Outreach and Educator Roundtable in fall 2012. The goal of what is intended to be a twice annual event is to alert other educators in the region to workshops, professional development opportunities we are planning, and ideas for shared products, lists of educators, and other tools that will improve our efficiency, provide economy of scale, and result in a "one-stop-shop" for teachers looking for opportunities to improve their knowledge of the Great Lakes and ability to

	incorporate Great Lakes literacy into their classrooms. We worked with the Great Lakes Aquarium to sponsor and organize a live-streaming event in association with Gustavus Adolphus College's Annual Nobel Conference during fall, 2012 (called "Our Global Oceans"). Local scientists presented short descriptions of their Great Lakes freshwater research paired with each of the live-streamed research talks. Sea Grant graduate students spoke with over 50 participants during this two-day event. MNSG worked with the National NEMO HUB to successfully host NEMO U8 in Duluth, in conjunction with the Great Lakes Sea Grant Network conference. NEMO U was successful; MNSG staff managed to find $5,750 in sponsorships and secured a grant from the National Sea Grant Office to cover $7,143 of expenses associated with the overlap day between NEMO U8 and the GLSG Network Conference, where a series of 7 workshops (including a Watershed Game Facilitator's Training and a Climate Adaptation Workshop) and site visits provided capacity-building training for participants from both conferences. NEMO U8 scored high marks from all 60 participants; 100% ranked the event either "Truly Splendid" (42%) or "Well Worth the Trip" (58%). The Great Lakes Sea Grant Network conference in fall 2012 was also successful. This event kicked off with the overlap day of training discussed above, and focused on significant time for project breakout sessions, with a total of 4.5 hours dedicated to currently active projects. This time was used for project planning purposes, to showcase completed work, and to strategize for future activities, as the work teams saw fit. Evaluations indicated that this event was highly rated among participants as well, with 100% rating the event as Excellent (61.5%) or Good (38.5%). One additional outcome of this event was securing Duluth as the location for the second session of the 2013 Sea Grant Academy, the first time the Academy will have been held on the Great Lakes. Program development funding was provided to a Large Lakes Observatory researcher to collect and analyze data after the 500 year flood event in June, 2012, to determine effects of the flood on the western arm of Lake Superior. Program development funding also went to a relatively new UMD researcher to begin evaluating PAH issues in local stormwater runoff ponds and the streams that drain them.
Summary	In 2012 MNSG accomplished outreach, education, and other activities that are worth noting.

Program	MN
Project Title	Climate Change Challenges - Tools for Vulnerability Assessments and Integration of Adaptation Goals and Strategies into Local Plans
Investigators	Jeffrey L. Gunderson (University Of Minnesota (UMN));
Partner	University of Wisconsin, Madison (UW); Wisconsin Sea Grant;

Description	This is a joint project of Wisconsin and Minnesota Sea Grant to provide climate adaptation implementation assistance for Great Lakes communities. A half-time specialist based at Minnesota Sea Grant in Duluth will focus on the Lake Superior coast of Minnesota and Wisconsin through collaboration with the Lake Superior National Estuarine Research Reserve (LS-NERR) in Superior. The project is modeled after the EPA/NOAA Smart Growth Implementation Assistance for Coastal Communities program that ran from 2003 through 2006. The program provided direct technical assistance from planning experts to communities interested in incorporating smart growth techniques in their development projects. Several efforts exist in Wisconsin and Minnesota to provide workshops and training on coastal climate adaptation. The next logical step is to provide direct technical assistance to coastal communities, including coastal tribal governments, to promote action on climate adaptation. The new climate extension staff will guide communities through a climate adaptation checklist. Assistance will be provided in a face-to-face informal format in local government offices complemented by a driving tour of coastal facilities and potentially threatened resources. A summary report, including the completed checklist, will be provided to the community shortly after the visit. If more detailed follow-up assistance is desired by local governments on specific climate adaptation topics, it would be provided by existing Wisconsin/Minnesota Sea Grant outreach specialists.
Progress	RELEVANCE – In 2012, an estimated 500-year storm struck Duluth, MN, and surrounding communities, causing widespread damage and a federal disaster declaration. The flood follows on the heels of 100-year rains in the region during the past decade. Recent climatic changes, including an increased frequency of intense storms, warmer air and lake temperatures, changing lake levels, and more unreliable winter weather, are causing uncertainty and difficulty for coastal communities and businesses. RESPONSE – MNSG partnered with other Great Lakes SG programs to conduct a needs assessment targeting community and resource managers, and with Oregon SG to conduct an in-depth assessment in one Lake Superior Community through interviews and surveys. MNSG partnered with WISG to hire a Climate Adaptation Extension Educator for Lake Superior communities. A checklist, "A Self-Assessment to Address Climate Change Readiness in Your Community," was developed to introduce communities to climate change issues, the community's climate-related vulnerabilities, and adaptation strategies. In addition, MNSG collaborated with MI and IL/IN Sea Grants to host climate adaptation training for Great Lakes Sea Grant and National NEMO Network conference participants. RESULTS – Communities need more information about intense storm frequency preparedness, winter tourism impacts, and a better understanding of what climate adaptation means according to assessments. In 2012, two Lake Superior communities completed the self-assessment checklist, identifying areas of potential vulnerability for their community; another two communities are in the process of completing the assessment. MNSG is working to assist these communities in following up on the results of the assessment. The City of Duluth agreed to share significant data resources with MNSG and the NOAA Coastal Services Center in a flood mitigation and green infrastructure project.
Summary	Lake Superior Communities are becoming more prepared for a changing climate as a result of MNSG's activities.

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Progress	Note: Below, the "Activity" subheadings refer to the MNSG Implementation Plan. The activities are coded according to focus area, crosscutting goal, and strategic initiative. Activity EXT1: (II-B-5, II-B-3, II-B-2) MNSG conducted maritime

transportation outreach benefitting the Great Lakes region by participating in numerous Great Lakes maritime industry meetings in both the US and Canada and by extending information to a variety of audiences. MNSG continued to expand Sea Grant's role in informing the maritime industry and port communities about the threats and opportunities in the transportation environment due to policy, climate, infrastructure, and technology changes. Through presentations on Climate Change and industry adaptation strategies at maritime industry meetings, MNSG contributed to an increasing general awareness and successfully petitioned both USACE and USCG in the Great Lakes to designate an official climate change liaison. MNSG presented at the GreenTec 2012 Conference in Quebec and published in July-Sept issue of the Great Lakes Seaway Review Magazine. MNSG served on the Harbor Technical Advisory Committee for Duluth/Superior. Ocean Policy and Marine Spatial Planning in the Great Lakes - In 2012, MN Sea Grant began participating with the NOAA Ocean Policy Team to consider "Marine Spatial Planning" in the Great Lakes. This was largely an "unfunded mandate" with limited resources for actual product development. In spite of this, MN Sea Grant volunteered to coordinate the effort to "map" the marine transportation needs of the Seaway. Working closely with the USCG, and NOAA, MNSG began exploring sources for basic data. MNSG coordinated a regional team to examine resources and interest. Ultimately we were able to collaborate with other groups like the "Great Lakes Environmental Assessment and Mapping program" (GLEAM) and the "USCG Marine Cadastre" to collect initial data. This has improved the data available to GLEAM, and added new dimensions to their data product. In the coming year, we plan to share the data collected with end users to see if it "tells the complete story" about areas of use and need for access. The map of maritime transportation use in the Great Lakes will be the first "interest specific" map to be completed and will set the standard for data quality, and appropriate mapping strategies for other interest groups as they begin to develop their "GIS maps of interest." Activity EXT2: (II-C-3) MNSG provided information on technical issues related to ballast water exchange and treatment options to professional, academic and lay audiences by helping to organize, sponsor and facilitate a meeting of the Great Lakes Ballast Water Collaborative (8/12, Duluth, MN). We also produced the meeting report, to inform state and federal ballast water policies, used by all the Great Lakes States (and Federal Agencies: EPA, USCG). In addition, we presented data and information to a variety of venues (MPCA Board Meeting, Upper-Midwest Invasive Species Conf. 2012, Duluth/Superior HTAC and to other local organizations). During 2012 the USCG and EPA promulgated their initial ballast water regulations. The work of the BWC changed how both Great Lakes stakeholders (US and Canadian) and the participating US Federal Agencies communicate and relate to each other in addressing critical Great Lakes issues. During 2012 the Great Lakes States were able to harmonize their ballast water treatment numeric standards for the first time; two lawsuits were withdrawn, and two were dismissed based on the work of the GL Ballast Water Collaborative. Activity EXT3: (IV-B-1) MNSG presented Lake Superior-specific climate change information relevant to maritime transportation to a variety of groups (International Joint Commission, Harbor Technical Advisory Committee, Propeller Club of America, Green Marine, St. Lawrence Seaway Development Corp., and the public). Activity EXT4: (II-B-6) MNSG continues to partner with industry, academia, and the government to understand and balance threats and opportunities unique to the Duluth-Superior Harbor. This includes providing support for the

development of the Erie Pier national pilot dredge re-use program, spearheading the 21st Ave. W. restoration and mitigation project (74 acres), and participating on the harbor's Freshwater Corrosion Task Force. MNSG staff served as Vice Chair of the Harbor Technical Advisory Committee, and worked closely the Duluth Seaway Port Authority, the Coast Guard and the Army Corps of Engineers, state agencies, and the Cities of Duluth, MN and Superior, WI. Activity EXT5: (II-B-5) MNSG supported Green Ports and Harbors programs, as well as the Great Lakes Network Clean Marina GLIR program and the international Green Marine initiative. 2012 marked the first certified "MN Clean Marinas." Activity EXT8: (II-C-4) MNSG's efforts to understand, communicate, and address concerns related to accelerated-freshwater corrosion continues through collaborations, research, and participation on the harbor's Freshwater Corrosion Task Force.   Activity EXT8: (II-C-5) Disposing of dredge materials is a critical issue to maintaining commercial and private ports and harbors in the Great Lakes. MNSG's efforts continue to inform and build strategies for addressing this issue. MNSG provided leadership and support for the development of Erie Pier, a national pilot dredge re-use program. (See impact statement.) Activity EXT9: (II-C-3, II-C-6, II-B-6) MNSG consulted with dozens of cities, watersheds, and University units about stormwater, nonpoint source pollution, and sustainable landuse. MNSG continued long-standing educational work with the Regional Stormwater Protection Team (RSPT) and the University of Minnesota Duluth Stormwater Committee. We assisted with education during the RSPT co-sponsored rain barrel sale, where 338 rain barrels were sold. We assisted homeowners with determining the best way to set up their barrel, and answered questions about how to use the water. During 2012, RSPT reached 2,391 individuals with a stormwater protection message, not including contacts at booths or through television or website resources. In 2012 MNSG applied for, and was awarded, a Minnesota GreenCorps position through the MN Pollution Control Agency. This provided a full-time Americorps position to MNSG to work with on stormwater education from October 2012-August 2013. This position has expanded the capacity of RSPT to reach individuals, students, and businesses, and will leave behind resources that others can continue using.   Accomplishments to January 2012 include: 1. Developed a new set of displays for RSPT, including seasonally-adjustable content 2. Coordinated a winter sidewalk and parking lot maintenance workshop, where 95% of participants would recommend the event to their colleagues, and 100% believed they could save money by following the recommendations. 3. Surveyed teachers to help coordinate classroom presentations through RSPT UMD Stormwater Committee - MNSG's assistance with the UMD Stormwater committee included revising, entering results, and analyzing a stormwater survey for students and staff, and coordinating the fall 2012 UMD Stormwater Steering Committee meeting. LEED Professional Course - MNSG collaborated with the UMD Continuing Education Department on developing a stormwater course for LEED professionals after being asked by the MN Chapter of the US Green Building Council to develop such a course to fulfill needed continuing education credits by LEED professionals. During 2012, MNSG designed the course instructional materials, which include approx. 2.5 hours of presentation, 5 exercises, and various supporting materials. The course has been reviewed by the MN Chapter of the USGBC, and we are in the process of finalizing before its expected release during 2013.   Activity EXT10: (II-B-2) The Lakeside Neighborhood Stormwater Reduction pilot project continues to mature. In 2012, MNSG led field trips to the project to show off

stormwater best management practices (BMPs).   Activity EXT11: (II-C-6) NEMO continues to be an active statewide program, and during 2012 the program expanded with 5 additional U of MN Extension Educators becoming engaged in NEMO programming statewide. Fourteen NEMO programs were conducted reaching hundreds of community leaders. The Northland NEMO website (www.northlandnemo.org) was visited about 1380 times a month in 2012. Training conducted by MNSG in "Linking Land Use to Water Quality" and the Watershed Game, and a new presentation focused on rural communities, has provided extension educators with the tools to begin programming in different parts of the state.   Understanding the value of the National NEMO University conference (NEMO U), MNSG staff convinced the NEMO Hub that our program could find the financial resources to successfully host NEMO U8 in Duluth, MN. ($5,750 in sponsorships and a grant from the National Sea Grant Office to cover $7,143 of expenses associated with the overlap day between NEMO U8 and the Great Lakes Sea Grant Network Conference). Because of the capacity building between NEMO U8 and the Network Conference, 7 workshops (including a Watershed Game Facilitator's Training and a Climate Adaptation Workshop) and a variety of site visits provided training for participants from both conferences. NEMO U8 scored high marks from the ~60 participants; 100% ranked the event either "Truly Splendid" (42%) or "Well Worth the Trip" (58%). NEMO efforts in the Vadnais Lakes Area resulted in participants leaving with a better understanding of phosphorous standards established by the TMDL (75%); this was a primary educational objective. Activity EXT12: (II-C-6) The City of Duluth zoning ordinance updates are complete. The Unified Development Chapter of the Duluth Legislative Code was passed in 2010. MNSG is extending the message about Duluth's laudable progress in protecting Lake Superior (see http://www.seagrant.umn.edu/newsletter/2012/02/a_new_chapter_for_a_seaside_city.html). Activity EXT13: (II-B-6, II-C-1) MNSG engaged communities in discussions about conservation design and smart growth. MNSG collaborated with the Landscape Arboretum on the 2012 Clean Water Summit where 82% of respondents said they left with a better understanding of the role of soil in green infrastructure and stormwater management. MNSG staff co-chaired the Summit, which attracted 225 participants. Ditch and Culvert Maintenance and Design - Previous work with the Weber Stream Restoration Initiative identified road ditch and culvert design and maintenance as priority issues for North Shore streams. As part of the GLRI, NRRI and Sea Grant received funding to develop a road ditch maintenance guidebook. This project kicked off in 2012 with the creation of an advisory committee and development and solicitation of a Request for Qualifications from consulting firms. We are currently awaiting MPCA approval before notifying the selected contractor.   Culvert Workshop - We also assisted DNR personnel in developing a culvert workshop for the region. This workshop was subsequently developed jointly with MNDNR, Laurentian Resources Conservation and Development, and BWSR, with funding from Minnesota's Lake Superior Coastal Program and is scheduled for March 2013. This workshop will focus upon on ditch and culvert design in the Lake Superior Watershed that will minimize hydrologic impacts, system failure/subsequent erosion, and maximize cost effective installation, and maintenance. The "Tipping Points" project is a Great Lakes Sea Grant Network project to develop ecological tipping point parameters for land use and water quality, and translate these tipping points into a tool to engage communities in developing action plans to address priority issues. During 2012, MNSG participated in developing the community engagement tools and

attended the kickoff workshop at Purdue. Activity EXT14: (II-B-1) With funding from the Great Lakes Observing System, MNSG held two workshops in Duluth for educators regarding the Teaching with Great Lakes Data website, (greatlakeslessons.com) housed at Michigan Sea Grant, and introduced two lessons created by MNSG that rely on buoy data from the western end of Lake Superior to teach about lake stratification, upwelling, and effects on Great Lakes fisheries. A third workshop was held in Madison, WI, in cooperation with WISG. A total of 72 K-12 teachers and informal educators were trained. Activity EXT16: (II-B-6) MNSG facilitated 5 meetings, forums, workshops, and events to improve sustainable environmental and economic decision-making. In addition, MNSG facilitated a multi-step process to develop a scoping document, outlining necessary precursor steps to take before convening a statewide "Water Congress" to review state statutes, policies, procedures, and plans related to managing state ground and surface water resources. We worked with the Water Resources Center and Humphrey Institute of UMN and the Minnesota Environmental Initiative to organize and facilitate the steering committee that developed the document, which was then submitted to the Minnesota legislature. MNSG also facilitated the strategic planning for the Forestry Team and Woodland Advisor Team of UMN Extension. Activity COM1: (II-B-3) Spilhaus biography: The University of Minnesota Press is reviewing the completed manuscript but has not committed to being its publisher (yet).   Activity COM2: (II-B-1) Mass communication about Sustainable Coastal Development reached a potential audience of 3,992,239. MNSG increased maritime transportation awareness and scientific/maritime literacy within the general public and among policy makers through numerous articles, presentations and on-line resources. MNSG facilitated the delivery of science-based information and resources to formal and informal education communities by participating in River Quest, and other outreach/educational events in 2012. Excluding the Northland NEMO website activity (visits=16,556), there were 2,955 unique page views to coastal development topics on the MNSG website: • Coastal Communities minus hypothermia and rip currents: 1,759 • Maritime: 1,196 Activity EDU1: (II-B-4) As in 2011, on-the-water programs, similar to A View from the Lake (conducted on Lake Superior), were conducted through the Northland NEMO program with the Mississippi Watershed Management Organization. Local elected and appointed leaders participated in the MNSG/NEMO Workshops "A View from the Big River." 85% indicated a gain in knowledge and some participants identified concepts that they did not know before the excursion. The lessons and materials developed from the Lake Superior cruise series were used in two educator professional development workshops and the "A View from the Lake educational website" is pending.   Activity EDU2: (II-B-4) The Watershed Game continues to be a valuable tool for working with local governments, citizen and school groups, and other organizations. In 2012, the three Watershed Game versions (lake, river, and stream) were revised and improved through the experiences of 17 facilitators. Train-the-trainer sessions added 85 facilitators in 10 states. The Indiana Watershed Academy has incorporated the Watershed Game as parts of its annual curriculum. The majority of participants in Watershed Game Train-the-Trainer sessions indicated the training provided them with skills strong enough to lead the curriculum in their own programs. The Watershed Game also won the "Superior Outreach Award" at the Great Lakes Sea Grant Network conference. Presentations at professional meetings about the game included the National American Fisheries Society Annual

	Meeting, August 2012. Activity EDU3: (II-C-2) MNSG used data, graphics, water quality impact information, best management practices, and data visualization tools from Lake Superior Streams to enrich seven workshops, as well as several presentations at professional meetings and outreach venues, including the Minnesota Wastewater Operators and a Northland News segment. Two lessons based on Lake Superior stratification and upwelling data from Lake Superior Streams data visualization tools and the Large Lakes Observatory Buoy were developed as part of the Great Lakes Observing System (GLOS) education project and will be posted on the Teaching with Great Lakes Data educational curriculum website hosted by Michigan Sea Grant.
Summary	MNSG contributed to ballast water management issues, the recycling of dredge materials, marine spatial planning, and community sustainability.

Program	MN
Project Title	Climate Change Challenges - Tools for Vulnerability Assessments and Integration of Adaptation Goals and Strategies into Local Plans
Investigators	Jeffrey L. Gunderson (University Of Minnesota (UMN));
Partner	University of Wisconsin, Madison (UW); Wisconsin Sea Grant;
Description	This is a joint project of Wisconsin and Minnesota Sea Grant to provide climate adaptation implementation assistance for Great Lakes communities. A half-time specialist based at Minnesota Sea Grant in Duluth will focus on the Lake Superior coast of Minnesota and Wisconsin through collaboration with the Lake Superior National Estuarine Research Reserve (LS-NERR) in Superior. The project is modeled after the EPA/NOAA Smart Growth Implementation Assistance for Coastal Communities program that ran from 2003 through 2006. The program provided direct technical assistance from planning experts to communities interested in incorporating smart growth techniques in their development projects. Several efforts exist in Wisconsin and Minnesota to provide workshops and training on coastal climate adaptation. The next logical step is to provide direct technical assistance to coastal communities, including coastal tribal governments, to promote action on climate adaptation. The new climate extension staff will guide communities through a climate adaptation checklist. Assistance will be provided in a face-to-face informal format in local government offices complemented by a driving tour of coastal facilities and potentially threatened resources. A summary report, including the completed checklist, will be provided to the community shortly after the visit. If more detailed follow-up assistance is desired by local governments on specific climate adaptation topics, it would be provided

	by existing Wisconsin/Minnesota Sea Grant outreach specialists.
Progress	With the Great Lakes Sea Grant Network, we obtained Great Lakes Restoration Initiative funding to continue ship- and land-based educator professional development throughout the Great Lakes states for the next four years, through a newly-minted program called Center for Great Lakes Literacy (www.cgll.org). Three graduate students (one in environmental education and two in MS programs in the aquatic sciences) and one technician (interested in graduate school in survey design and evaluation) were mentored in internship programs to develop their skills in outreach, lesson development, and evaluation. In cooperation with the Lake Superior NERR Education Coordinator, MNSG sponsored an Outreach and Educator Roundtable in fall 2012. The goal of what is intended to be a twice annual event is to alert other educators in the region to workshops, professional development opportunities we are planning, and ideas for shared products, lists of educators, and other tools that will improve our efficiency, provide economy of scale, and result in a "one-stop-shop" for teachers looking for opportunities to improve their knowledge of the Great Lakes and ability to incorporate Great Lakes literacy into their classrooms. We worked with the Great Lakes Aquarium to sponsor and organize a live-streaming event in association with Gustavus Adolphus College's Annual Nobel Conference during fall, 2012 (called "Our Global Oceans"). Local scientists presented short descriptions of their Great Lakes freshwater research paired with each of the live-streamed research talks. Sea Grant graduate students spoke with over 50 participants during this two-day event. MNSG worked with the National NEMO HUB to successfully host NEMO U8 in Duluth, in conjunction with the Great Lakes Sea Grant Network conference. NEMO U was successful; MNSG staff managed to find $5,750 in sponsorships and secured a grant from the National Sea Grant Office to cover $7,143 of expenses associated with the overlap day between NEMO U8 and the GLSG Network Conference, where a series of 7 workshops (including a Watershed Game Facilitator's Training and a Climate Adaptation Workshop) and site visits provided capacity-building training for participants from both conferences. NEMO U8 scored high marks from all 60 participants; 100% ranked the event either "Truly Splendid" (42%) or "Well Worth the Trip" (58%). The Great Lakes Sea Grant Network conference in fall 2012 was also successful. This event kicked off with the overlap day of training discussed above, and focused on significant time for project breakout sessions, with a total of 4.5 hours dedicated to currently active projects. This time was used for project planning purposes, to showcase completed work, and to strategize for future activities, as the work teams saw fit. Evaluations indicated that this event was highly rated among participants as well, with 100% rating the event as Excellent (61.5%) or Good (38.5%). One additional outcome of this event was securing Duluth as the location for the second session of the 2013 Sea Grant Academy, the first time the Academy will have been held on the Great Lakes. Program development funding was provided to a Large Lakes Observatory researcher to collect and analyze data after the 500 year flood event in June, 2012, to determine effects of the flood on the western arm of Lake Superior. Program development funding also went to a relatively new UMD researcher to begin evaluating PAH issues in local stormwater runoff ponds and the streams that drain them.
Summary	In 2012 MNSG accomplished outreach, education, and other activities that are worth noting.

Program	MS-AL
Project Title	Integrating Hazard Mitigation into Local Planning to Support Community Resiliency on the Mississippi Gulf Coast
Investigators	
Partner	
Description	
Progress	Relevance: If true integration of the two plans is to occur, the elected officials must be aware of the need and the benefit. It will be ultimately up to the local elected officials to adopt and implement any policy recommendations, so educating them is . Response: Elected officials have been informed about the project and the importance by written correspondence, brief meeting presentations and at various conferences and seminars. There have been one-on-one conversations and discussions as well. Results: Because the project is still in progress, it is difficult to report the results. However, all elected officials appear to be receptive to the idea of better/more integration and appreciate getting a better understanding of how the two distinct planning processes take place (comp and hazmit).
Summary	When knowledge and information is transferred to local elected officials, they are able to make better informed decisions regarding planning policy.

Program	MS-AL
Project Title	A Generic Television Program on Flooding With Local Application
Investigators	Emily Sommer (Grass Roots, Inc.); John Jacob (Texas Sea Grant); Kevin White (University of South Alabama (USA)); Mark Bunting (WKRG (Channel 5, Mobile, AL));
Partner	

Description	Keywords: resiliency, best management practices, storm mitigation, beach nourishment, storm water management, flood plains, watersheds, hurricanes, storms, flooding, flood maps, flood insurance, storm surge Objectives: This program will show the general public the effect that poor development practices have on flooding events. DVDs will widen the audience for this important information. Elected officials will be better able to implement storm water management solutions if more members of the public understand the true cost/benefits of better land management. (1) To develop a public understanding of the rainfall cycle in a watershed and how current development practices contribute to flooding. (2) To characterize storm surge and inland flooding issues. (3) To describe flood zones and flood insurance coverage. (4) To provide cost-efficient solutions for storm water management. Methodology: grassroots, inc., a 50 I (c) 3 organization, will partner with WKRG-TV (Mobile CBS affiliate), KHOU-TV (Houston CBS affiliate), Texas Sea Grant, and the Civil Engineering Department ofthe University of South Alabama, Mobile, Alabama to produce a half-hour television program on coastal flooding. The generic program will be produced by WKRG and will include six two-minute slots for local videos, produced by KHOU. Texas Sea Grant will assist in the video work in Texas. The pilot program will be aired in prime time by KHOU. Rationale: Large population growth in coastal areas and poor development practices have increased flooding from coastal storms. Hazard mitigation efforts by communities are often politically unpopular. Television is an excellent medium for reaching the public on important environmental safety issues. Increased public support will encourage better mitigation policies.
Progress	Relevance: Widespread Houston TV viewing audience on flooding problems, solutions. Simultaneous Spanish language broadcast. DVDs provided to viewing audience in English/Spanish. DVDs used in a variety of educational venues, such as Alabama Floodplain Managers convention in "Train the Trainer" packages for educating city/county officials, etc. Mobile Public Library has 15 copies and reports good usage by library patrons. Fifty Mobile, AL, Realtors received 3- hours CE credit for a presentation of "But it never flooded here before!" using DVD and Mobile scriptwriters. Response: Alabama Floodplain Managers report positive reception to presentations of "Train the Trainer" packages. Realtors were very responsive and have asked for a repeat presentation in 2014. Mobile Public Library put DVDs into circulation 11/1/12 and reports 15 checkouts since then. Results: Thousands of English and Spanish speaking Houston TV viewers became aware of Houston's coastal topography and its weather patterns, which produce much flooding. Solutions are provided to encourage public support of local efforts to control flooding and to become aware of effects of development on the watershed. The 16-minute generic portion of the program is available for application by many other communities.
Summary	

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	MS-AL
Project Title	Measuring the Relative Financial Vulnerability of Municipal Governments to Tropical Natural Disaster Risk
Investigators	
Partner	
Description	
Progress	Relevance: Local governments, such as municipalities and counties, face tremendous financial challenges recovering from natural disaster events, such as hurricanes. Reduced financial health from previous hurricanes make these local public institutions more financially vulnerable to the next storm. Local governments are under increased vulnerability to future cost share requirements that were waived for most Hurricane Katrina emergency costs. Response: University economists evaluated the capacity of existing local governments' financial health prior to and following Hurricane Katrina. In addition, the economists evaluated the financial costs of emergency operations and debris removal these local governments billed. Results: Coastline counties with the highest emergency costs would see their solvency condition deteriorate fourfold if they were required to fund 25% of the future emergency costs of a Katrina-sized hurricane. Local governments will need to improve their solvency condition to two to four times the previously healthy thresholds for solvency to maintain a risk-adjusted financially healthy condition. It is expected adoption of improved solvency conditions will reduce interest costs from borrowing to finance future disaster emergency costs.
Summary	Recap: Financial health of most vulnerable Gulf Coast communities to a future Katrina-sized tropical natural disaster need to be improved their solvency condition two to four fold to cover expected local cost-share requirements.

Program	MS-AL
Project Title	Gulf of Mexico Coastal Training Program Initiative for Resilient Communities
Investigators	
Partner	

Description	
Progress	Relevance: Coastal storms threaten Gulf of Mexico communities and the economic systems that these communities support. Our partnership recognized the benefits of utilizing the Coastal Resilience Index to help identify community resilience needs and then to provide technical assistance to these communities to help them become better prepared before, during and after coastal storms through awareness, planning, preparation and response. Many communities either lack the specific expertise or staffing support to undertake these efforts without outside assistance. Response: An existing partnership of National Estuarine Research Reserves in the Gulf of Mexico worked together to identify communities in their areas of focus to participate in this effort. Work is already underway in Moss Point, Mississippi, and Franklin County, Florida. Results: While difficult to determine specific results at this time, it is clear that community leaders in each community that has completed the Coastal Resilience Index are more aware of the capabilities and vulnerabilities of their community to respond to and recover from coastal storms. We anticipate having more concrete results to report at the end of the project period.
Summary	Recap: The Coastal Resilience Index and assistance provided by this project will assist communities in the Gulf of Mexico to increase their awareness of the threat posed by coastal storms and to improve their preparedness, ability to weather and capabilit

Program	MS-AL
Project Title	Determining Best Practices When Reseeding Neighborhoods with Non-profit Rebuilding after Coastal Storms
Investigators	
Partner	
Description	
Progress	Relevance: When nonprofits help people rebuild their homes, those people benefit immediately, but do these rebuilt homes encourage neighbors? We wanted to find out if rebuilt homes encouraged neighbors to come home sooner. We also wanted to find out if one rebuilt home is enough or if a cluster of rebuilt homes is required. Response: We

	worked with Phoenix of New Orleans in Mid-City New Orleans. We have presented the preliminary work at two conferences of academics. We hope to present one more time, analyze the data more robustly, and to submit our work to academic journals. We believe that our academic work can be used by city planners and responders. Results: Survival analysis suggests that when Phoenix of New Orleans (PNOLA) rebuilt houses neighbors returned faster.
Summary	The benefits of rebuilding homes is greater than we might have thought.

Program	MS-AL
Project Title	Building Code Education and Smart Home Expo
Investigators	
Partner	
Description	
Progress	Relevance: Given the hazards experienced by homeowners across the Gulf Coast in recent years and escalating insurance premiums, much attention has been given to construction practices and how to strengthen homes and reduce the risk to life and property. It is important to share the innovative products and techniques with code officials and homeowners, not only from coastal areas, but from throughout the region, as community resilience and hazard mitigation are not merely coastal issues. The Coastal Code Supplement of the 2012 International Residential Code incorporates standards to make new construction more resilient to storms. One of the most important items in the new code is a sealed roof deck. The Institute for Business and Home Safety has conducted research proving that the roof is one of the most vulnerable parts of a home and the most common cause of water damage during a hurricane is due to roof covering damage and water infiltration. At the time of construction or during the process of reroofing the homeowner can drastically reduce this risk for approximately $700. However, the new code which makes structures more resilience has not yet been widely adopted by communities. This event specifically addresses sustainable coastal development and hazard resilience in coastal communities, promoting healthy coastal communities as outlined in MASGC's strategic plan. Specifically coastal decision makers have benefited from this expo by being educated on their risk assessment and specific achievable steps that can be taken to reduce risk, reduce the insurance burden on their

	citizens, and allow their communities to recover from disasters more quickly. Response: This project brought the experts to the code officials and home builders and provided a forum for all involved to network and learn about new hazard resilient products and techniques. The City of Orange Beach partnered with Mississippi-Alabama Sea Grant, Smart Home America and the Gulf Coast Chapter of the International Code Council to bring together the key players in hazard resilient construction, including the International Code Council and the Institute for Business and Home Safety (IBHS). This was very important for the homeowners because the insurance premium discounts in Alabama are based on IBHS's Fortified program. Sea Grant and Habitat for Humanity also supported educational activities for builders and contractors to raise awareness of the benefits and costs associated with following the Coastal Code. Sea Grant also sponsored an expo that benefited coastal decision makers by learning about risk assessment and specific achievable steps that can be taken to reduce risk, reduce the insurance burden on their citizens, and allow their communities to recover from disasters more quickly. Results: The events were instrumental in providing the needed training to allow many Baldwin County, Alabama to adopt the 2012 Edition of the International Code Series, the most recent codes in the nation. Also several of the jurisdictions adopted a code-plus supplement based on the Fortified program mandating stronger and better built homes within their jurisdictions. The 2012 IRC and the Coastal Code Supplement or some modified version of it, were adopted by the Baldwin County Commission and 9 out of 13 municipalities within the county. Municipalities not yet adopting are gathering information from the rest to most likely adopt in the spring of 2013. The economic impact can be estimated by calculating the average number of permits pulled and thus the number of homes that are more resilient as a result. It is estimated that in a 50-year storm event, nearly 50% of homes will be damaged, with an average $11,600 claim per home. Annually in Baldwin County, Alabama, there are an average of 750 new construction projects and 350 re-roofs. If every one of these roofs were strengthened to the Fortified Home standard, which includes the sealed roof deck, the estimated savings for the community in prevented losses would be 6 million dollars. This does not include the displacement cost for the families in these homes, which will be drastically reduced.
Summary	Recap: The implementation of the 2012 International Residential Code and Coastal Code Supplement has made Baldwin County the leader in coastal resiliency in relation to building codes and enforcement. This will make every home now built in the participat

Program	MS-AL
Project Title	Smart Home America

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Investigators	
Partner	
Description	
Progress	Relevance: Given the hazards experienced by homeowners across the Gulf Coast in recent years and escalating insurance premiums, much attention has been given to construction practices and how to strengthen homes and reduce the risk to life and property. It is important to share the innovative products and techniques with code officials and homeowners, not only from coastal areas, but from throughout the region, as community resilience and hazard mitigation are not merely coastal issues. The Coastal Code Supplement of the 2012 International Residential Code incorporates standards to make new construction more resilient to storms. One of the most important items in the new code is a sealed roof deck. The Institute for Business and Home Safety has conducted research proving that the roof is one of the most vulnerable parts of a home and the most common cause of water damage during a hurricane is due to roof covering damage and water infiltration. At the time of construction or during the process of reroofing the homeowner can drastically reduce this risk for approximately $700. However, the new code which makes structures more resilience has not yet been widely adopted by communities. This event specifically addresses sustainable coastal development and hazard resilience in coastal communities, promoting healthy coastal communities as outlined in MASGC's strategic plan. Specifically coastal decision makers have benefited from this expo by being educated on their risk assessment and specific achievable steps that can be taken to reduce risk, reduce the insurance burden on their citizens, and allow their communities to recover from disasters more quickly. Response: This project brought the experts to the code officials and home builders and provided a forum for all involved to network and learn about new hazard resilient products and techniques. The City of Orange Beach partnered with Mississippi-Alabama Sea Grant, Smart Home America and the Gulf Coast Chapter of the International Code Council to bring together the key players in hazard resilient construction, including the International Code Council and the Institute for Business and Home Safety (IBHS). This was very important for the homeowners because the insurance premium discounts in Alabama are based on IBHS's Fortified program. Sea Grant and Habitat for Humanity also supported educational activities for builders and contractors to raise awareness of the benefits and costs associated with following the Coastal Code. Sea Grant also sponsored an expo that benefited coastal decision makers by learning about risk assessment and specific achievable steps that can be taken to reduce risk, reduce the insurance burden on their citizens, and allow their communities to recover from disasters more quickly. Results: The events were instrumental in providing the needed training to allow many Baldwin County, Alabama to adopt the 2012 Edition of the International Code Series, the most recent codes in the nation. Also several of the jurisdictions adopted a code-plus supplement based on the Fortified program mandating stronger and better built homes within their jurisdictions. The 2012 IRC and the Coastal Code Supplement or some

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Summary	Recap: The implementation of the 2012 International Residential Code and Coastal Code Supplement has made Baldwin County the leader in coastal resiliency in relation to building codes and enforcement. This will make every home now built in the participat

Program	MS-AL
Project Title	Coastal Resilience Gulf of Mexico-Methods, Data and Web-Based Mapping Applications to inform Coastal Communities on the Risks of Sea Level Rise
Investigators	
Partner	
Description	
Progress	Relevance: Decision-makers need the critical information necessary to support choices for managing human and natural communities in the face of the coastal changes that are. Despite a growing awareness of the reality of global climate change and sea-level rise, local decision makers often lack the tools to visualize future scenarios and identify alternatives for effective. As a consequence, they are unable to comprehensively integrate SLR and coastal hazard risk into their decision-making to reduce vulnerability while simultaneously increasing the resilience of human and natural communities. Response: Chris Shepard and Jorge Brenner organized a joint workshop with Dr. Sam Brody of Texas A&M Galveston, Director of the Texas Institute for Sustainable Coasts. Shepard and Brenner traveled to Galveston Dec. 5-7 to present at the Planning for Sustainable Communities workshop developed in partnership with Texas A&M. More

	information can be found here: http://hrrc.arch.tamu.edu/outreach/events/ The workshop offered continuing education credits for participants through both the Association of State Floodplain Managers and the American Planning Association. Results: We provided information on the use of habitats to reduce coastal hazards risk and provided training on the Gulf of Mexico Decision Support tool to nearly 30 participants ranging from municipal planners to academic researchers and natural resource managers. Established a point of contact with multiple Galveston Bay communities including Shoreacres, Baytown, League City, Quintana Island, Galveston and Mont Belvieu. We are currently following up with these communities to identify further local level activities and support.
Summary	Recap: At our December 2012 workshop, we brought together nearly 30 Galveston Bay area practitioners and planners to learn about hazard mitigation techniques and tools with a focus on green solutions, such as land acquisition and/or restoration.

Program	MS-AL
Project Title	Development of Sea Level Rise Adaptation Planning Procedures and Tools Using NOAA Sea Level Rise Impacts Viewer
Investigators	
Partner	
Description	
Progress	Relevance: In this study, we have conducted surveys to better understand how sea-level rise is addressed in the urban planning process and how the current NOAA sea-level rise viewer tool contributes in the process. Local planners have been asked for input through interviews and surveys. The online survey was distributed with the help of Tampa Bay Regional Planning Council to local planning professional network. Survey targets include planners, city managers, council members and planning and engineering professionals in the four counties and 20 municipalities in Tampa Bay Region. The questions help the scientific community, researchers and decision support tool developers better understand what have been done for sea-level rise adaptation in practice and how further decision support tool could be useful to support the coastal resilience building towards sea-level rise adaptation. It provides useful suggestions for further usability improvements to the current NOAA sea-level viewer tools, and the suggestions have been provided to the NOAA sea-level rise viewer development group. Response: The survey has 49 respondents and 24 effective ones from

	different agencies, including 7 municipal planning agencies, four county agencies, state and regional environmental protection agency and department of transportation, private planning and engineering companies, and water supply authority. Some municipal agencies did not provide an effective response because they are small municipals who do not have specialized planning staff and their planning work are done by the county planning agencies, from whom we already got effective responses. Results: The results show that the current NOAA SLR viewer provides a good base for adaptation decision support, however, based on the survey further improvements are necessary to better serve the adaptation planning needs through: • Identifying the multidisciplinary and multiagency nature of adaptation planning • Providing policy toolkit/cases and evaluation for education purpose • Adding more useful functions (infrastructure vulnerability, integrated vulnerability, adaptation evaluation) • Adding more data (i.e. critical infrastructure, transportation and utility) • Using more user-friendly interface • Identifying different adaptation scenarios based on distance to the sea • Integrating adaptation evaluation with local comprehensive planning.
Summary	Recap: The time range, strategies, funding situation and implementation status of local adaptation planning have been better understood through the research. These findings provide the current sea-level rise adaptation planning tool developers a better un

Program	NC
Project Title	Vulnerability of coastal sewage collection systems to inundation
Investigators	Lawrence Cahoon (University of North Carolina, Wilmington (UNCW));
Partner	
Description	OBJECTIVES: 1) Identify all central wastewater treatment systems in NC's 20 coastal counties and obtain 2008-2009 Discharge Monitoring Report daily flow data from NC DENR/DWQ. 2) Obtain 2008-2009 daily rainfall and temperature data from NWS weather stations proximal to WWTP locations. 3) Obtain 2008-2009 sea level data from NOAA tide gauge stations. 4) Analyze sewer flow data as functions of rainfall patterns, temperature and sea level, and generate regression-based estimates of effects of each driver of extra flow in collection systems. Analayze day of the week and month of the years as block effects in a kmixed model ANOVA. 5) Use GIS-based analysis of elevation distribution in each collection system area to relate response of flow to sea level variation to service area elevation patterns. METHODOLOGY: Multiple regression will be used to analyze effects of daily rainfall, cumulative rainfall over various

	intervals, temperature and daily high tidal height on flows through sewer collection systems. Regression coefficients will be used as estimates of normalized effects of rainfall, temperature and elevated sea level on flows, e.g., mgd (inch of rain)-1, oC-1 or (meter sea level above datum)-1. GIS analysis will be used to map the service areas of each system and determine the fraction of each area within a range of elevations. Effects of sea level rise will then be related statistically to the fractions of each service area below a range of elevations in order to determine the degree of vulnerability to sea level effects associated with low elevations among the whole set of systems we examine. RATIONALE: Coastal development is driving straight into conflict with climate change and rising sea level. A significant portion of the public resources at risk in this conflict is investment in infrastructure, such as central waste collection and treatment systems. How much of it is already at risk to inundation from episodic events and long-term sea level rise? How much more expense and risk should we expect and plan for? How wise is future such investment? This project examines the risks to coastal wastewater treatment systems from excess water, including sea water, leaking into waste collection systems as sea level rises. A study we have just published shows the risk is quite real, but virtually no other information is available to quantify this risk at larger scales, which likely varies in proportion to location and the quality of system design, construction and maintenance. The proposed study will generate this information for the entire NC coastal region through analysis of data already available.
Progress	
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of

	polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	N.H. Sea Grant carries out much of its climate-related work in partnership with the New Hampshire Coastal Adaptation Workgroup (NHCAW or CAW), a coalition of 19 organizations and agencies focused on helping coastal communities in New Hampshire prepare for extreme weather and climate effects. CAW provides communities with education, facilitation and technical assistance that improve their access to climate-related information and people, as well as helps them build their capacity and adjust their plans, regulations and actions to take changing climate conditions into account. In 2012, CAW received the Daniel Quinlan award for Outstanding Achievement in Community and Regional Planning from the Rockingham Planning Commission. The award recognizes those in the region who have made significant contributions to sound community and regional planning and have fostered inter-municipal cooperation and collaboration. This award stems from the successes of five public workshops around climate change hosted by CAW since 2010, a quarterly CAW newsletter, and nearly a dozen collaborative climate change adaptation projects with N.H. coastal communities.
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);

Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	Recognizing and implementing climate adaptation, as such, is a relatively new task for municipalities and for those who support local decision making. In recognition of this challenge, in 2012 N.H. Sea Grant staff compiled a set of about 45 observed and potential outcomes communities might achieve with assistance from adaptation practitioners. The list was developed to help recognize, guide and document steps communities take to improve their resilience. The outcomes are grouped into five categories – Increasing Community Capacity, Conducting Research and Assessments, Modifying Plans, Adopting Regulations and Policies, and Taking Municipal Actions (voluntarily). The outcomes were shared with the 19 partner organizations and agencies composing New Hampshire's Coastal Adaptation Workgroup (CAW) and are being adopted and used as a tool to help define climate adaptation for CAW and partners at the community- and project-level. Having a shared definition of community-based adaptation outcomes should help climate adaptation practitioners within the region and elsewhere to communicate more clearly, coordinate efforts more effectively, and track results collectively over time. It also helps communities recognize what types of actions constitute climate adaptation. The list will continue to evolve as new outcomes emerge and others fade based on actual community actions.
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);

Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	With funding from a National Sea Grant Law Center grant, N.H. Sea Grant coordinated legal research to accompany the development of new 100-year floodplain maps by a UNH-led team for a coastal watershed. The new maps reflect risk from current and projected precipitation rates and land use and differ from the most recently available FEMA maps. Engagement between the mapping team and a local advisory committee was an important component of the project in order to ensure the maps were relevant and to help identify users and barriers to use. The legal research was inspired by suggestions from the advisory committee that fear of legal challenges could be a barrier to use of the maps. The study, carried out by four faculty and 18 students at Vermont Law School, investigated five primary questions, including one exploring possible options available to communities for managing development within floodplains. The results, publically reported in 2012, confirm that N.H. communities can and should do what they can through planning, regulatory and non-regulatory strategies to protect health and property within the new floodplains. In order to minimize the likelihood of legal challenges, community actions should be based on sound planning, appropriate statutes and clear purposes, and they should preserve some economic viability for the affected land. It is anticipated that the information from this important study will help reduce barriers to communities taking action to protect health and property on evolving floodplains. The results of the legal research were presented in June 2012, both to a national audience at the Coastal Society Conference as well as in a public forum within the mapped watershed. Several opportunities are planned to share the findings with institutional, state and regional audiences.
Summary	

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	Beginning in 2010, a UNH-led team funded by the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) developed a new set of 100-year floodplain maps for a coastal N.H. watershed based on current and projected climate and land use conditions. The mapping team engaged an advisory committee in order to make sure that the maps were relevant for community use and to help identify users and barriers to use. NHSG worked with the mapping team in 2012 to assess the effects of engaging with the advisory committee on the map products and the project overall. Seven substantial changes to the maps were made by the technical team based on input from the advisory committee. These included changes to the terminology, symbology, scenarios and tables used. The advisory committee also identified the need for legal research in order to reduce barriers to use of the maps. Based on NHSG's initial assessments, the mapping team produced better products based on input from the advisory committee. The advisory committee as well as other stakeholders pointed out the need for training to accompany the maps, so training and additional use assessment are being planned for 2013-14.
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	N.H. Sea Grant carries out most of its climate adaptation work with its partners in the N.H. Coastal Adaptation Workgroup (CAW), a coalition composed of representatives from 19 federal, state, regional, municipal and academic institutions. CAW members support communities wishing to improve their climate adaptation and community resilience by delivering information, education, facilitation and technical assistance in tune with a community's social, economic and environmental situation. CAW members deliver adaptation outreach to broad audiences through events like its workshops series, Water, Weather, Climate and Community, and its website, newsletter and blog located within StormSmart Coasts, an online resource for coastal decision makers. CAW held its first workshop in 2010 and two more each in 2011 and 2012. The 2012 workshops introduced a regional climate assessment, Climate Change in the Piscataqua/Great Bay Region: Past, Present and Future and New Hampshire based examples of climate adaptation. By the end of 2012, CAW had worked with representatives from over 25 communities in three different states. The sixth workshop on Building Resilience through Better Floodplain Management is scheduled for spring 2013. CAW also conducts targeted outreach through specific funded projects. Since its inception, CAW members have secured over $2.5M in grant funding for technical tool development, technical assistance and community engagement and received a

	regional planning award. In terms of community accomplishments, CAW has generated increases in knowledge, motivation and confidence levels related to climate adaptation as reported by over 200 community participants and documented community changes in capacity building (human, financial and technical resources), data and information access, planning tools, regulation and policies, and voluntary actions for over 15 communities. Presentations about CAW's projects, methods and measures will be offered at national, state and institutional conferences and meetings during 2013. A formal evaluation of the model is being considered so that successful elements of the coalition and its methods can be shared with other programs and improvements can be made.
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	In 2012, N.H. Sea Grant and the Great Bay National Estuarine Research Reserve, along with an interdisciplinary team of researchers from the University of New Hampshire and staff from the town of Exeter, embarked on a two-year

	collaborative effort to develop a robust climate adaptation plan for Exeter (CAPE). Sea Grant's participation in the project's engagement committee has led to a sound outreach plan to connect with stakeholders in a meaningful way, including plans to coordinate a citizen working group to guide the implementation of the project. Sea Grant leveraged its connections with the N.H. Coastal Adaptation Workgroup to bring in a partner with expertise on – and an ongoing interaction with – the business community. This effectively created a complete outreach effort to all sectors of the community. N.H. Sea Grant has also started development of a CAPE project website for the community to access information about climate change, information about the project, the timeline of activities, and how to contact the members of the project team. Sea Grant's partnership on the CAPE project benefits Exeter through increased awareness and understanding of the project thorough engagement and access to the project team.
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.

Progress	In 2011, University of New Hampshire researchers released an assessment of the climate of coastal New Hampshire titled, Climate Change in the Great Bay/Piscataqua Region: Past, Present, and Future. During 2012, N.H. Sea Grant condensed the 54-page assessment into a two-page user-friendly handout appropriate for lay audiences at workshops and events, and also made it available online. This tool was distributed at several workshops as well as to 129 people in the winter edition of the Coastal Adaptation Workgroup's newsletter, The Crow's Nest, which is composed and edited by NHSG staff. This climate assessment summary efficiently and effectively communicates the state of coastal N.H.'s climate, and is of great benefit to partners and to the diverse audience affected by climate change who seek to gain knowledge and understanding of the local climate.
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	N.H. Sea Grant and project partners are working with the City of Dover to create a role-play game simulation to aid area

	communities in planning for climate change. During 2012, N.H. Sea Grant and partners interviewed Dover city officials, emergency management professionals, concerned citizens, business owners and community leaders to collect the data for the game. This project is one of four concurrent case studies investigating the utility of this approach in fostering adaptation planning. The results from this effort will benefit the target communities and others around the country searching for an effective way to identify climate vulnerabilities and to think through socially, economically and environmentally acceptable adaptation strategies.
Summary	

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H. Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	RELEVANCE: N.H.'s coastal watershed includes 42 communities, most of which are small and have few professional staff members. Recent studies, including one conducted by Clean Air-Cool Planet (2011), indicate that such communities are experiencing the effects of a changing climate, but are unsure what to do about it. RESPONSE: In 2012 using leveraged

	funding, New Hampshire Sea Grant staff and partners applied a modified version of the NOAA Roadmap (a participatory community-based process) to assist Newfields, a coastal watershed community, to assess its climate vulnerabilities, identify priorities and take steps to improve its preparedness for climate effects. RESULTS: Newfields formed committees that developed an adaptation action plan with two foci: stormwater management and emergency preparedness. Their stormwater management strategies include hosting Forging the Link (an education program about the economics of low impact development), inventorying their stormwater infrastructure, updating their master plan for climate effects, and adopting subdivision and site plan review regulations to reduce polluted runoff. The town is actively improving preparedness through a new emergency communication system and development of a calendar for town residents with storm-related tips. Residents are also purchasing discounted generators through a bulk purchase approved by the town's selectboard, representing a combined $600 in savings of purchase and installation costs and further economic benefit from recaptured lost productivity during power outages.
Summary	RECAP: A small coastal community in New Hampshire uses assistance from NHSG to take concrete steps to become more resilient in the face of a changing climate.

Program	NH
Project Title	Coastal Climate Change Adaptation Initiative
Investigators	Julia Peterson (New Hampshire Sea Grant);
Partner	Antioch University New England; Carbon Solutions New England (CSNE); City of Dover, NH; City of Portsmouth, NH; Clean Air — Cool Planet; Coastal Services Center (US DOC, NOAA, NOS, CSC); Coastal Services Center, Northeast Region (US DOC, NOAA, NOS, CSC);
Description	In the Northeast, occurrences of extreme precipitation and the intensity of rainfall are increasing. Local officials have had to deal with the flooding, damaged infrastructure and property, culvert failures, human health issues, effects of polluted runoff and pressure on municipal budgets and services that accompany extreme precipitation numerous times in recent years. In coastal areas in the Northeast, these effects are often exacerbated by high rates of imperviousness and flood prone development. The serious economic, environmental and social effects of severe weather and projected changes in climate behoove communities to do what they can to prevent damage and prepare for a "new normal" in terms of climate conditions, however planning and readiness activities at the municipal level are often usurped by immediate threats, budgetary restraints, political pressures and discomfort accessing or applying scientific data. N.H.

	Sea Grant in collaboration with its partners can help coastal communities make progress in climate adpatation by offering assistance to communities when, where, how and with what they need help.
Progress	In 2012, N.H. Sea Grant helped to create a new webpage on StormSmart Coasts, The Journalists Room, as a resource to support local journalists in reporting rich and accurate stories related to climate change. Journalists can quickly access key information for reporting on climate change, including climate science 101 materials, climate impacts, climate media, and contact information for community leaders to get local perspectives.
Summary	

Program	NH
Project Title	Understanding the Mechanisms Controlling Storm Event Nitrogen Fluxes from the Lamprey River Watershed Using Continuous in situ Sensors
Investigators	Brian Pellerin (US Geological Survey (US DOI, USGS)); Jamie Shanley (US Geological Survey (US DOI, USGS)); Julia Peterson (New Hampshire Sea Grant); Kenneth Toppin (US Geological Survey (US DOI, USGS)); Michelle Daley (University of New Hampshire (UNH)); Wilfred Wollheim (University of New Hampshire (UNH)); William McDowell (University of New Hampshire (UNH));
Partner	New Hampshire Agricultural Experiment Station; New Hampshire Sea Grant; Town of Durham, NH; University of New Hampshire (UNH); University of New Hampshire, Institute for the Study of Earth, Oceans and Space (UNH EOS); US Geological Survey (US DOI, USGS);
Description	The Great Bay of New Hampshire has been classified as nitrogen impaired due to elevated nitrogen loads from its surrounding watershed. Elevated nitrogen loads result from both point and non-point sources associated with intensified suburbanization as well as residual agricultural activity. A large proportion of non-point nitrogen exports occur during storm events due to enhanced mobilization and transport. Yet, very little information regarding storm event nutrient dynamics exists due to logistical difficulties of collecting sufficient samples throughout entire storm event hydrographs across seasons. New in situ optical sensor technology is now available that allows continuous nutrient monitoring in streams and rivers, offering the potential to better understand sources and fate of non-point nutrient pollution. The overarching objective of this research is to: Understand the mechanisms that control N exports from the Lamprey River watershed to the Great Bay over a range of climate/flow conditions and to share information about likely source conditions and possible mitigation strategies with local land use planners and decision makers responsible for reducing locally generated N inputs. Our approach is to permanently and continuously deploy in situ sensors at the

	USGS discharge gauging station near Newmarket to monitor nitrogen and carbon fluxes across storms, seasons, and years. Sensors will include a Satlantic SUNA (for nitrate), a Turner Designs C6 (for fluorescent dissolved organic matter, turbidity, chlorophyll A) and a Hydrolab Multisonde (for dissolved oxygen, conductivity, pH, and water temperature). Steps will be taken to ensure the highest quality data, including regular cleaning to minimize biofouling; blank and standard checks; and grab sample collection and analysis to validate sensor measurements, and to develop proxies for dissolved and particulate organic nitrogen. We will combine these measurements in the Lamprey River mainstem with identical measurements in headwater catchments of varying land use (e.g. suburban, forest, agriculture) and in the Great Bay itself, offering the potential to link nonpoint source dynamics across scales. Measurements will be telemetered to project specific web sites making the information available in real time for use in outreach campaigns. These measurements will improve quantification of non-point nutrient inputs to the Great Bay and will provide greater sensitivity to monitoring of change over time, either due to natural climate changes, or to changing human activities, including management specifically targeting nitrogen control. Our objectives are directly related to the N.H. Sea Grant Strategic Plan's emphasis on Sustainable Coastal Development with the specific goal that: Coastal communities in New Hampshire's coastal watersheds employ strategies that protect ocean and coastal resources from degradation associated with the built environment and growing demands on coastal resources. Both undergraduate and graduate students will benefit from knowledge of the operation, quality assessment, and data interpretation associated with the deployment of novel sensor technology. Our outreach objective will be to increase the knowledge and confidence levels of community leaders by providing them with better access to and interpretation of local, real-time and rigorous research on nutrient dynamics within the Great Bay system.
Progress	Using new in situ optical sensor technology in 2012, NHSG-funded researchers collected continuous data in Lamprey River headwaters to better understand the dynamics and the fate of non-point nutrient pollution in the watershed. They compared three sites: forested, suburban with septic waste and organic dairy. The forested site showed no nitrate concentration response during storms. The overall nitrate fluxes in the suburban and agricultural sites increased during storms and showed diurnal patterns during baseflow conditions. These data are helping scientists and resource managers by improving knowledge of watershed processes and informing nutrient flux models.
Summary	

Program	NH
Project Title	Understanding the Mechanisms Controlling Storm Event Nitrogen Fluxes from the Lamprey River Watershed Using

	Continuous in situ Sensors
Investigators	Brian Pellerin (US Geological Survey (US DOI, USGS)); Jamie Shanley (US Geological Survey (US DOI, USGS)); Julia Peterson (New Hampshire Sea Grant); Kenneth Toppin (US Geological Survey (US DOI, USGS)); Michelle Daley (University of New Hampshire (UNH)); Wilfred Wollheim (University of New Hampshire (UNH)); William McDowell (University of New Hampshire (UNH));
Partner	New Hampshire Agricultural Experiment Station; New Hampshire Sea Grant; Town of Durham, NH; University of New Hampshire (UNH); University of New Hampshire, Institute for the Study of Earth, Oceans and Space (UNH EOS); US Geological Survey (US DOI, USGS);
Description	The Great Bay of New Hampshire has been classified as nitrogen impaired due to elevated nitrogen loads from its surrounding watershed. Elevated nitrogen loads result from both point and non-point sources associated with intensified suburbanization as well as residual agricultural activity. A large proportion of non-point nitrogen exports occur during storm events due to enhanced mobilization and transport. Yet, very little information regarding storm event nutrient dynamics exists due to logistical difficulties of collecting sufficient samples throughout entire storm event hydrographs across seasons. New in situ optical sensor technology is now available that allows continuous nutrient monitoring in streams and rivers, offering the potential to better understand sources and fate of non-point nutrient pollution. The overarching objective of this research is to: Understand the mechanisms that control N exports from the Lamprey River watershed to the Great Bay over a range of climate/flow conditions and to share information about likely source conditions and possible mitigation strategies with local land use planners and decision makers responsible for reducing locally generated N inputs. Our approach is to permanently and continuously deploy in situ sensors at the USGS discharge gauging station near Newmarket to monitor nitrogen and carbon fluxes across storms, seasons, and years. Sensors will include a Satlantic SUNA (for nitrate), a Turner Designs C6 (for fluorescent dissolved organic matter, turbidity, chlorophyll A) and a Hydrolab Multisonde (for dissolved oxygen, conductivity, pH, and water temperature). Steps will be taken to ensure the highest quality data, including regular cleaning to minimize biofouling; blank and standard checks; and grab sample collection and analysis to validate sensor measurements, and to develop proxies for dissolved and particulate organic nitrogen. We will combine these measurements in the Lamprey River mainstem with identical measurements in headwater catchments of varying land use (e.g. suburban, forest, agriculture) and in the Great Bay itself, offering the potential to link nonpoint source dynamics across scales. Measurements will be telemetered to project specific web sites making the information available in real time for use in outreach campaigns. These measurements will improve quantification of non-point nutrient inputs to the Great Bay and will provide greater sensitivity to monitoring of change over time, either due to natural climate changes, or to changing human activities, including management specifically targeting nitrogen control. Our objectives are directly related to the N.H. Sea Grant Strategic Plan's emphasis on Sustainable Coastal Development with the specific goal that: Coastal communities in New Hampshire's coastal watersheds employ strategies that protect ocean and coastal resources from degradation associated with the built environment and growing demands on coastal resources. Both undergraduate and graduate

	students will benefit from knowledge of the operation, quality assessment, and data interpretation associated with the deployment of novel sensor technology. Our outreach objective will be to increase the knowledge and confidence levels of community leaders by providing them with better access to and interpretation of local, real-time and rigorous research on nutrient dynamics within the Great Bay system.
Progress	The Great Bay Estuary is classified as nitrogen-impaired due to elevated nutrient loads from its surrounding watershed, but very little information is available about the nutrient dynamics during storm events. In 2012, NHSG-funded researchers collected continuous data in the mainstem of the Lamprey River to better understand these nutrient fluxes that likely end up in the estuary. The in situ water quality data showed that there were two major flushes of nitrate during the fall of 2012 with more minor flushes after that, indicating that storms cause varying degrees of nitrate concentrations. These data are helping scientists and resource managers by improving quantification of non-point nutrient inputs to Great Bay and providing greater sensitivity to monitoring changes in nutrient inputs over time.
Summary	

Program	NH
Project Title	Understanding the Mechanisms Controlling Storm Event Nitrogen Fluxes from the Lamprey River Watershed Using Continuous in situ Sensors
Investigators	Brian Pellerin (US Geological Survey (US DOI, USGS)); Jamie Shanley (US Geological Survey (US DOI, USGS)); Julia Peterson (New Hampshire Sea Grant); Kenneth Toppin (US Geological Survey (US DOI, USGS)); Michelle Daley (University of New Hampshire (UNH)); Wilfred Wollheim (University of New Hampshire (UNH)); William McDowell (University of New Hampshire (UNH));
Partner	New Hampshire Agricultural Experiment Station; New Hampshire Sea Grant; Town of Durham, NH; University of New Hampshire (UNH); University of New Hampshire, Institute for the Study of Earth, Oceans and Space (UNH EOS); US Geological Survey (US DOI, USGS);
Description	The Great Bay of New Hampshire has been classified as nitrogen impaired due to elevated nitrogen loads from its surrounding watershed. Elevated nitrogen loads result from both point and non-point sources associated with intensified suburbanization as well as residual agricultural activity. A large proportion of non-point nitrogen exports occur during storm events due to enhanced mobilization and transport. Yet, very little information regarding storm event nutrient dynamics exists due to logistical difficulties of collecting sufficient samples throughout entire storm event hydrographs across seasons. New in situ optical sensor technology is now available that allows continuous nutrient

	monitoring in streams and rivers, offering the potential to better understand sources and fate of non-point nutrient pollution. The overarching objective of this research is to: Understand the mechanisms that control N exports from the Lamprey River watershed to the Great Bay over a range of climate/flow conditions and to share information about likely source conditions and possible mitigation strategies with local land use planners and decision makers responsible for reducing locally generated N inputs. Our approach is to permanently and continuously deploy in situ sensors at the USGS discharge gauging station near Newmarket to monitor nitrogen and carbon fluxes across storms, seasons, and years. Sensors will include a Satlantic SUNA (for nitrate), a Turner Designs C6 (for fluorescent dissolved organic matter, turbidity, chlorophyll A) and a Hydrolab Multisonde (for dissolved oxygen, conductivity, pH, and water temperature). Steps will be taken to ensure the highest quality data, including regular cleaning to minimize biofouling; blank and standard checks; and grab sample collection and analysis to validate sensor measurements, and to develop proxies for dissolved and particulate organic nitrogen. We will combine these measurements in the Lamprey River mainstem with identical measurements in headwater catchments of varying land use (e.g. suburban, forest, agriculture) and in the Great Bay itself, offering the potential to link nonpoint source dynamics across scales. Measurements will be telemetered to project specific web sites making the information available in real time for use in outreach campaigns. These measurements will improve quantification of non-point nutrient inputs to the Great Bay and will provide greater sensitivity to monitoring of change over time, either due to natural climate changes, or to changing human activities, including management specifically targeting nitrogen control. Our objectives are directly related to the N.H. Sea Grant Strategic Plan's emphasis on Sustainable Coastal Development with the specific goal that: Coastal communities in New Hampshire's coastal watersheds employ strategies that protect ocean and coastal resources from degradation associated with the built environment and growing demands on coastal resources. Both undergraduate and graduate students will benefit from knowledge of the operation, quality assessment, and data interpretation associated with the deployment of novel sensor technology. Our outreach objective will be to increase the knowledge and confidence levels of community leaders by providing them with better access to and interpretation of local, real-time and rigorous research on nutrient dynamics within the Great Bay system.
Progress	NHSG-funded researchers deployed in situ sensors in the Lamprey River to gain a better understanding of nutrient dynamics during storm events and baseflow conditions. A variety of outreach materials were produced in 2012 as a result of this research, including a video and news article that detail the deployment of these new sensors and explain the importance of water quality monitoring for better understanding watershed and aquatic processes. These outreach materials help increase the knowledge and confidence levels of the public and community leaders by providing them with better access to and interpretation of local, real-time research on nutrient dynamics within the Great Bay Estuary tributaries.
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Progress	NHSG-funded researchers conducted continuous water quality monitoring in the Lamprey River to learn more about nutrient dynamics within the Great Bay Estuary. As part of the outreach efforts associated with this project, researchers and graduate students organized a sensor demonstration exhibit for elementary and middle school students for the 2012 UNH Know The Coast Day program. The hands-on exhibit demonstrated water quality monitoring in a manner that they could understand, such as salt washing off roads into streams and measured by conductivity, and rivers "breathing" through photosynthesis and decomposition as measured by dissolved oxygen. This interactive educational exhibit increased marine and environmental literacy among local youth.
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Progress	Researchers have developed a new method of determining the relationship between nutrient concentration and stream discharge. Their new method of processing the data allows the clear visualization of the concentration-discharge relationship, providing valuable information about the source and behavior of nutrients and whether they vary over seasons.
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Progress	A new Internet-accessible database was developed to store Lamprey River water quality data collected by NHSG-funded researchers, the U.S. Geological Survey and UNH. This database allows resource managers, researchers, watershed associations and other interested parties to have access to important historical and current data to help address management issues in the Lamprey River watershed.
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Progress	RELEVANCE: NHSG-funded researchers conducted water quality studies in the Lamprey River using new sensors that allow for continuous monitoring during storm events and baseflow conditions. RESPONSE: Researchers utilized these studies and technological efforts as a core part of the UNH graduate class Aquatic Ecosystems (NR 751/851). RESULTS: Students in the class attended field trips to the site in 2012 where they learned how to install and operate the in situ water quality sensor and surveyed the water quality in streams from agricultural, forested and suburban areas. These

	experiences were highly valuable in training the future workforce to more effectively monitor and manage water resources and nutrients within a watershed.
Summary	RECAP: NHSG-funded research on Lamprey River nutrient dynamics has directly supported a graduate-level class at UNH and provided hands-on experience in sensor installation and operation for students interested in entering the natural resources career fiel

Program	NH
Project Title	Climate Change Adaptation and Ecosystem Service Resilience in Northeast Coastal Communities: Quantifying Economic Values and Tradeoffs for Regional Decision Support
Investigators	Robert Johnston (Clark University);
Partner	Connecticut River Estuary Regional Planning Agency; Southeastern Connecticut Council of Governments; Town of Old Saybrook, CT; Town of Waterford, CT;
Description	The proposed project will develop rigorous social science methods that, when integrated with natural science data and scenarios from Coastal Resilience and supplementary sources, will enable users to evaluate economic benefits, costs and tradeoffs of adaptation strategies. Unlike incomplete estimates based solely on infrastructure and engineering costs, the proposed results will incorporate a more comprehensive perspective including ecosystem service values provided by vulnerable coastal ecosystems, yielding new mechanisms to inform adaptation that generates sustainable benefits. The project engages with partners seeking to assist coastal communities with hazard adaptation to ensure that results will have immediate impact. Outcomes will serve as models for communities region-wide facing similar hazards.
Progress	Working to assess the vulnerability of Northeast coastal communities to hazards from a changing climate and evaluate how communities can best adapt to these vulnerabilities, outreach efforts to date have fostered important dialogue on the issue of climate and extreme weather preparedness in two coastal communities in Connecticut, Waterford and Old Saybrook.
Summary	

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	NJ
Project Title	Economic Vulnerability to Climate Change on the Jersey Shore: Promoting Adaptation, Resilience and Sustainability in Coastal New Jersey
Investigators	Robin Leichenko (Rutgers University);
Partner	
Description	Abstract is the same for 2012-14 omnibus and the 2012 minibus submission for social science subsidy OBJECTIVES: The objectives of the project are to: identify and quantify economic vulnerabilities to climate change for coastal communities in New Jersey; identify and evaluate options for adaptation using cost-benefit techniques; disseminate economic vulnerability and adaptation data to decision makers; and, develop tools that will enable decision makers to incorporate vulnerability and adaptation data through existing local planning mechanisms. METHODOLOGY: The project adopts a mixed-method approach that uses quantitative information on economic costs of impacts and adaptation, qualitative information obtained through stakeholder interviews, spatial vulnerability mapping using Geographic Information Systems (GIS), and web-based decision support tools. RATIONALE: The economic dimensions of climate change impacts and adaptation are a critical concern for municipal, county, and state officials and non-profit environmental and economic development organizations. While prior studies have estimated the aggregate economic costs of sea-level rise as the result of climate change for coastal areas, there is only limited knowledge of the broader suite of economic vulnerabilities associated with climate change impacts in New Jersey's coastal communities, as well as the costs associated with a range of adaptation options. EXPECTED BENEFITS: The project will provide information about the economic vulnerabilities and adaptation options that will contribute to efforts to promote sustainable development and hazard-resilient communities in coastal New Jersey. Users of the project research and web tools will include representatives from municipal and county governments, state agencies and non-profits.
Progress	NJSGC continues to update and maintain a website describing New Jersey's public access laws to coastal stakeholders, which was made possible with the support of National Sea Grant Law Center through Maine Sea Grant. In 2010, NJSGC developed a website that made the laws pertaining to public access in New Jersey more readily available to our coastal stakeholders. As an extension of this work with support from NJDEP CMO, the website contains the summary results of a public access survey investigating beach access in New Jersey administered by NJSGC. Nearly 1600 beach goers answered the survey (over 900 onsite) on questions pertaining to beach access on over 10 New Jersey beaches during the summer season in 2010. This survey generated significant interest including three radio interviews. In 2011, the main NJ Coastal Access website averaged over 100 visits a month. NJ Coastal Access - njseagrant.org/njcoastalaccess/index.html Beach Access Survey - njseagrant.org/njcoastalaccess/survey.html
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Progress	With input from an active coastal stakeholder committee and website design with the NJSGC Communications Department, the NJSGC developed a Coastal Heritage New Jersey website that was launched in early 2010. This site provides information on attractions, monuments/ memorials, museums, historic districts and other destinations celebrating the maritime heritage and culture of the Jersey Shore and Delaware Bay. Users can find out where to learn more about lighthouses and navigation aids, coastal defenses, boat-building and fishing cultures, historic districts and

	early cultures. The website has been consistently averaging close to 350 visits a month for 2011. njseagrant.org/Coastal_Heritage_NJ.html All Coastal Heritage Sites were also added to Panoramio and now appear on Google Earth. The photos and corresponding information have gotten 828 views from the time they were posted (November, 2011) through the end of January, 2012. Other uses and applications for this information are being investigated.
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Progress	The Virginia Sea Grant (VASG), in collaboration with the other Sea Grant (SG) programs in New York, New Jersey, Delaware, and Maryland, and the Coastal Zone Management (CZM) programs in those states, proposes to conduct a Mid-Atlantic Coastal Community Climate Adaptation Planning & Implementation project through a collaborative planning and competitive project implementation award process, in conjunction with the Mid-Atlantic Regional Council on the Oceans (MARCO). VASG and our regional SG and CZM programs propose to addresses sea level rise and inundation priorities identified in 1) the December 2009 National Atmospheric and Oceanic Administration (NOAA) and U.S. Geological Society (USGS) Sea Level Rise and Inundation Community Workshop (Culiver, et al. 2010), and 2) the MARCO Actions, Timelines, and Leadership to Advance the Mid-Atlantic Governor's Agreement on Ocean Conservation (MARCO 2009) workplan's climate goals through a competitive Request for Proposal (RFP) that fully engages and accesses the university-based expertise in the Mid-Atlantic and generates innovative, science-based solutions to regional sea level rise and inundation problems. In 2011, all partner programs met to develop a regional RFP focusing on how communities will respond to SLR and inundation in the Mid-Atlantic. Further development was completed through conference calls and email discussion. All programs then distributed RFP to potential researchers and were available to answer questions. Seven proposals were received and the steering committee of state Sea Grant Programs selected the winning proposal through discussion and information provided from external peer reviewers. Research is currently ongoing.
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Progress	In 2012, NJSGC received a mini-grant from the National Sea Grant Law Center to fund a collaborative symposium: Legal and Policy Approaches to Support Regional Ocean Planning in New Jersey and the Mid-Atlantic. The symposium will focus on identifying innovative and robust legal and policy approaches that build upon current initiatives and address timely and critical issues for New Jersey and the region, offshore energy (mainly wind); regional marine and spatial planning, and natural resource management. Partners for the symposium are Monmouth University Urban Coast Institute, Seton Hall University Scholl of Law, and the Environmental Law Institute. Partners have developed a symposium for April 2013 drawing legal and environmental experts from the mid-Atlantic region.
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Investigators	Robin Leichenko (Rutgers University);
Partner	
Description	Abstract is the same for 2012-14 omnibus and the 2012 minibus submission for social science subsidy OBJECTIVES: The objectives of the project are to: identify and quantify economic vulnerabilities to climate change for coastal communities in New Jersey; identify and evaluate options for adaptation using cost-benefit techniques; disseminate economic vulnerability and adaptation data to decision makers; and, develop tools that will enable decision makers to incorporate vulnerability and adaptation data through existing local planning mechanisms. METHODOLOGY: The project adopts a mixed-method approach that uses quantitative information on economic costs of impacts and adaptation, qualitative information obtained through stakeholder interviews, spatial vulnerability mapping using Geographic Information Systems (GIS), and web-based decision support tools. RATIONALE: The economic dimensions of climate change impacts and adaptation are a critical concern for municipal, county, and state officials and non-profit environmental and economic development organizations. While prior studies have estimated the aggregate economic costs of sea-level rise as the result of climate change for coastal areas, there is only limited knowledge of the broader suite of economic vulnerabilities associated with climate change impacts in New Jersey's coastal communities, as well as the costs associated with a range of adaptation options. EXPECTED BENEFITS: The project will provide information about the economic vulnerabilities and adaptation options that will contribute to efforts to promote sustainable development and hazard-resilient communities in coastal New Jersey. Users of the project research and web tools will include representatives from municipal and county governments, state agencies and non-profits.
Progress	The Development of a Regional Ocean Research Plan for the Mid-Atlantic Region is a four-year project (2008-2012) that set out to identify and analyze research needs associated with ocean and coastal issues in the Mid-Atlantic region along the Atlantic coast from New Jersey to North Carolina, involving the states of New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. The project sets out to identify and analyze research needs associated with ocean and coastal issues in the Mid-Atlantic

	region. The project focused on five priority issue-areas that were deemed as the most pressing issues facing the ocean and coastal areas of the Mid-Atlantic region: Climate Change, Offshore Energy, Water Quality and Quantity, Ecosystem Structure and Function, and Human Dimensions. The Research Plan was developed using a building block approach to identify priority research needs for the Mid-Atlantic region. All material and documents are available online as a way to make the planning document a living one, especially to regional associations such as MARCO and MARACOOS. The final document was released in September 2012 and continues to be distributed to regional stakeholders and decision makers. http://www.midatlanticoceanresearchplan.org/sites/www.midatlanticoceanresearchplan.org/files/u6/MidAtlanticRegionalOcean ResearchPlan-Final.pdf
Summary	

Program	NY
Project Title	Preparing Coastal Constituents and Communities for Climate Change
Investigators	Bunting-Howarth, Katherine (New York Sea Grant);
Partner	American Society of Civil Engineers (ASCE); Cornell Cooperative Extension; Great Lakes Sea Grant Network; New York State Department of Environmental Conservation (NY DEC); New York State Department of State;
Description	New York Sea Grant and the National Sea Grant Office both have priorities related to preparing coastal communities for the hazards associated with climate change. Two projects-one on Long Island and the other in the Great Lakes -will be conducted which will address these priorities. In Long Island the objective of the project is to have coastal decision makers and stakeholders better prepared to respond and adapt to shoreline erosion impacts associated with climate change by increasing awareness and encouraging the proper use of living shorelines as an environmentally sustainable erosion management strategy. This will be achieved by establishing a Living Shorelines Steering Committee/Working Group which will compile, synthesize and distribute information and data on existing living shorelines with emphasis on potential NY applications. This information will be used to convene a technical workshop on living shorelines in February for state and local officials, property owners and managers, marine consultants and contractors, and NGOs. The information and resources resulting from this effort will also be used as a basis for producing written and web based materials. In the Great Lakes project, NYSG will collaborate with the Great Lakes Sea Grant Network (GLSGN) to develop tools in support of the climate change component of Sea Grant's coastal resiliency efforts. Developed tools will: identify

	the needs of target audience; identify the need for risk assessment tools; communicate the needs to tool development; coordinate tool development and field testing; assess the cost/benefit of planning efforts; and assist in drafting adaptation plans when necessary.
Progress	With funding from Save Our Seashores, Inc., a non-profit organization focused on beach conservation and utilization, New York Sea Grant updated and revised its popular bulletin, "Long Island's Dynamic South Shore: A Primer on the Forces and Trends Shaping our Coast". Over 2,000 copies have been requested and are being distributed by the National Park Service (NPS), Soil Conservation and Water Conservation Service, shorelines homeowner groups, teachers and the public. NPS incorporated portions of the bulletin in their Fire Island Visitor's web site. Newsday, Long Island's largest daily is using the publication in the development of an upcoming series on climate change and sea level rise and has requested permission to use graphics in their paper.
Summary	

Program	NY
Project Title	Preparing Coastal Constituents and Communities for Climate Change
Investigators	Bunting-Howarth, Katherine (New York Sea Grant);
Partner	American Society of Civil Engineers (ASCE); Cornell Cooperative Extension; Great Lakes Sea Grant Network; New York State Department of Environmental Conservation (NY DEC); New York State Department of State;
Description	New York Sea Grant and the National Sea Grant Office both have priorities related to preparing coastal communities for the hazards associated with climate change. Two projects-one on Long Island and the other in the Great Lakes -will be conducted which will address these priorities. In Long Island the objective of the project is to have coastal decision makers and stakeholders better prepared to respond and adapt to shoreline erosion impacts associated with climate change by increasing awareness and encouraging the proper use of living shorelines as an environmentally sustainable erosion management strategy. This will be achieved by establishing a Living Shorelines Steering Committee/Working Group which will compile, synthesize and distribute information and data on existing living shorelines with emphasis on potential NY applications. This information will be used to convene a technical workshop on living shorelines in February for state and local officials, property owners and managers, marine consultants and contractors, and NGOs. The information and resources resulting from this effort will also be used as a basis for producing written and web based

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Progress	RELEVANCE The Town of Shelter Island requested NYSG assistance in evaluating an erosion problem on a barrier spit protecting an important harbor. RESPONSE NYSG compiled information, including historical aerial photographs, old shoreline maps and dredging records to identify the causes of the problem and management alternatives. Through presentations and a site visit, a NYSG specialist discussed the findings with representatives of the town, the non-governmental organization, the trust that owned the land, and local residents. RESULTS The town is using this information to develop a project coordinated with the county to begin strategically placing material dredged from the harbor inlet to restore sand transport to the eroding areas. The managers of the land trust used information provided by NYSG to modify their beach management practices to eliminate ineffective dune building practices saving resources and money and reducing marine debris.
Summary	The Town of Shelter Island and Local NGO used NYSG information to eliminate ineffective dune building practices.

Program	NY
Project Title	Preparing Coastal Constituents and Communities for Climate Change
Investigators	Bunting-Howarth, Katherine (New York Sea Grant);
Partner	American Society of Civil Engineers (ASCE); Cornell Cooperative Extension; Great Lakes Sea Grant Network; New York State Department of Environmental Conservation (NY DEC); New York State Department of State;
Description	New York Sea Grant and the National Sea Grant Office both have priorities related to preparing coastal communities for the hazards associated with climate change. Two projects-one on Long Island and the other in the Great Lakes -will be conducted which will address these priorities. In Long Island the objective of the project is to have coastal decision makers and stakeholders better prepared to respond and adapt to shoreline erosion impacts associated with climate change by increasing awareness and encouraging the proper use of living shorelines as an environmentally sustainable erosion management strategy. This will be achieved by establishing a Living Shorelines Steering Committee/Working

	Group which will compile, synthesize and distribute information and data on existing living shorelines with emphasis on potential NY applications. This information will be used to convene a technical workshop on living shorelines in February for state and local officials, property owners and managers, marine consultants and contractors, and NGOs. The information and resources resulting from this effort will also be used as a basis for producing written and web based materials. In the Great Lakes project, NYSG will collaborate with the Great Lakes Sea Grant Network (GLSGN) to develop tools in support of the climate change component of Sea Grant's coastal resiliency efforts. Developed tools will: identify the needs of target audience; identify the need for risk assessment tools; communicate the needs to tool development; coordinate tool development and field testing; assess the cost/benefit of planning efforts; and assist in drafting adaptation plans when necessary.
Progress	As a member of the American Society of Civil Engineers Coastal Ocean and Ports Research Institute's Coastal Zone Committee, NYSG provided leadership in the creation of the Living Shorelines subcommittee to develop engineering standards for living shoreline erosion control projects. NYSG is working with this committee to develop a national online database of living shoreline projects that will provide managers, planners, engineers and property owners with better information on the design and performance of these projects. (American Society of Civil Engineers). NYSG is serving on the planning committee for the Northeast Shore and Beach Preservation Association Biennial Regional Conference to be held in New Jersey in 2013. As a result of Sea Grant's participation, the committee will be including a special session on Living Shorelines which will be co-chaired by NY Sea Grant's coastal processes specialist.
Summary	

Program	NY
Project Title	Towards an Integrated Multi-model Storm Surge Prediction System for Coastal New York
Investigators	Brian A. Colle (State University of New York, Stony Brook (SUNY)); Charles N. Flagg (State University of New York, Stony Brook (SUNY)); Malcolm J. Bowman (State University of New York, Stony Brook (SUNY)); Nickitas Georgas (Stevens Institute Of Technology);
Partner	National Weather Service (US DOC, NOAA, NWS); State University of New York, Stony Brook (SUNY); Stevens Institute Of Technology;
Description	Several groups (NWS, universities, technical institutes) are currently running storm surge models, but there has been little inter-comparison or integration of these models. Since each storm has its own unique characteristics and behavior,

	no one model is always the most accurate at predicting surge events. A good solution is a forecast obtained by combining model outputs which will produce the most reliable predictor for a wide range of storm event scenarios. This project aims to create a more accurate ensemble-based and wave setup enabled storm surge model prediction system that will be used consistently by NWS and regional offices of emergency management for better outcomes in dealing with extreme weather events, including coastal flooding issues.
Progress	Sea Grant research provides improved capacity for future storm surge predictions Several groups (NWS, universities, technical institutes) are currently running storm surge models, but there has been little inter-comparison or integration of these models. Since each storm has its own unique characteristics and behavior, no one model is always the most accurate at predicting surge events. A good solution is a forecast obtained by combining model outputs to produce the most reliable predictor for a wide range of storm event scenarios. Sea Grant funded this project to create a more accurate ensemble-based and wave setup-enabled storm surge model prediction system to be used consistently by NWS and regional offices of emergency management to improve predictions associated with extreme weather events, including coastal flooding issues. The project contributes to NYSG's focus area of improved hazard resilience in New York coastal communities by helping the NYC metropolitan region to better predict and respond to surges from extreme storms through the expected use of the improved storm surge model prediction system. Timely information from the Storm Surge Group at Stony Brook University was delivered to stakeholders via social media that corrected misinformation about storm surge levels during hurricane Sandy. Also, work began on the integration of the Stony Brook Storm Surge ensemble and NOAA ETSS models. The research team also did time series analysis of observed sea levels at Montauk Point, Bellport, Point Lookout, Sandy Hook and wave heights at two NOAA buoy stations (44065 and 44025). The team also developed an interpolation routine for the new Penn State Atmospheric Model to improve the ADCIRC ocean model and MM5 weather model.
Summary	

Program	OH
Project Title	Climate Initiative -- Ohio Sea Grant Minibus FY2012/2013
Investigators	Christina Dierkes (Ohio Sea Grant); Jill Jentes Banicki (Ohio Sea Grant);
Partner	

Description	Objectives: A new dedicated Climate Extension Educator will be hired and located at the Columbus OHSG program office. An advisory group representing potential end users, as well as those representing key state, regional, and federal partners in climate change education and training will be established. Overall goals and objectives are to develop Great Lakes capacity to extend climate information, products, and services to resource managers and the general public and includes the following: Increase capacity for climate adaptation training and delivery; Develop K-12 climate curriculum to be shared with state educational programs; and Work with others in the development of the GLRI and other funded climate education, outreach and literacy campaign. Rationale: A changing Great Lakes climate has implications for long-term environmental, economic, and social stability. Communities can better prepare for these changes by bolstering their ability to diversify revenue sources in response, mitigating impacts before they occur, and adapting to new conditions. Yet their abilities and motivations to do so are often constrained by lack of knowledge about available resources, limited dedicated staff, lack of knowledge about climate change and its impacts, and lack of technical capabilities. Community delays in enacting climate preparedness may also be due to lack of citizen and political demand for change. This lack of demand is based on inadequate knowledge and awareness at the constituency level, demonstrating a need to enact programming at both the decision maker and local citizenry levels. Ohio Sea Grant (OHSG) has been a leader for more than 20 years in developing regional climate change outreach strategies and in coordinating and assessing Great Lakes Sea Grant Network activities to reduce redundancy and strengthen Sea Grant's efforts to make a difference. Through its Great Lakes climate curricula and Stone Laboratory climate courses, OHSG has created regional climate change curricula and led education programs to train and inform teachers and the public on climate-related impacts facing the Great Lake region. However, much more needs to be done for Great Lakes citizens and communities to adequately prepare for a changing climate. Methodology: Increased Extension capacity through a dedicated Climate Educator will be achieved through extension outreach methods and activities that allow OHSG to build upon its existing climate-related work, as well as to develop new strategies for creating change. Proven outreach education methodology (including new high technology) will be utilized including use of advisory committees and local extension outreach. The project methods will include: Increasing OHSG and Great Lakes capacity for climate adaptation training and delivery; Work on developing K to 12 climate curriculum to be shared with state educational programs; and, Work with others in the development of the GLRI and other funded climate education, outreach and literacy campaigns.
Progress	2012 Relevance: Climate change and its related impacts affect factors that influence the daily lives of the general public, such as infrastructure, public health, agriculture, and water quantity. Yet very few understand what impacts they could face from a state or Great Lakes regional perspective. Response: To strategically plan climate outreach for the state and help localize the climate change issue, Ohio State University created the OSU Climate Change Outreach Team in 2008. The team, representing 10 departments within Ohio State including Ohio Sea Grant and Cooperative Extension, works with 16 state and regional partners to coordinate climate education and outreach initiatives within the state and region.

	Using survey results, the group developed the monthly climate webinar series, Global Change, Local Impacts, to focus on regional climate impacts. The monthly series brings in experts from around the Great Lakes region to discuss issues and impacts we will encounter regionally as our climate changes. Results: More than 2,650 participants representing 200 organizations from around the country have attended the 10 monthly webinars in 2012 with 93% acknowledging they learned new information and would share it. The National Park Service and USEPA, as well as 8 secondary schools and college courses are using the webinars as teaching tools and the website is used as a professional development resource for natural resources professionals with 21,000 unique visitors. More than 5,775 people have participated in the 26 webinars since the series inception in 2009 and another 14,000 have accessed its webinar archives.
Summary	Recap: In 2012, the OSU Climate Change Outreach Team, a multi-departmental effort that created the monthly Global Change, Local Impact climate webinar series, have helped nearly 21,000 unique web visitors better understand the regional impacts of climate

Program	OH
Project Title	Great Lakes Coastal Storms Small Grant Program
Investigators	Christopher Winslow (Ohio Sea Grant); Jeffrey Reutter (Ohio Sea Grant);
Partner	
Description	OBJECTIVES: Develop and manage a coastal storms small grant program for the Great Lakes that will support projects designed to reduce the loss of property, infrastructure, life, health, personal injuries, and in general reduce negative impacts resulting from coastal storms. METHODOLOGY: Beginning 1 September 2012, the Ohio Sea Grant Program will develop, coordinate, and manage a coastal storms small grant program for the Great Lakes to build capacity and fill gaps in the development of tools and other products needed to serve coastal storm constituents. We will form the Great Lakes Coastal Storms Coordinating Committee composed of the Sea Grant Directors form Minnesota, Wisconsin, Illinois/Indiana, Michigan, Ohio, Pennsylvania, New York, and Lake Champlain to aid in the development and management of the small grants program. We will also consult with the National Coastal Storms Program Office (CSP). With the help of these two groups, we will also develop an Advisory Committee to serve as the review panel to aid in the ranking of research and outreach proposals. We will use a two-step process with preprosals followed by full proposals and will follow NOAA Sea Grant Office peer review processes typically implemented by each state Sea Grant

	Program. This process includes solicitation of written peer reviews for each proposal followed by a meeting and ranking by the Advisory Committee. The request for proposal language may identify a ratio of research to outreach projects to be funded in advance after consultation with the Coordinating and Advisory Committees and will indicate size and duration of typical awards. The small grants program will encourage leveraging, however non-federal funds will not be required. To develop funding priorities, in addition to consulting with the three groups mentioned above, we will seek advice from newly hired Regional Coastal Storms Specialists, the Great Lakes Network of Extension and Communication Specialists, state Coastal Management Programs, NERR programs in the region, the Great Lakes Environmental Research Laboratory, NOAA Weather Service Offices, and the Great Lakes Observing System. This is a three-year project. During year one we will identify partners and create the support committees. We will also develop the research and outreach priorities and the call for proposals. Preproposals will be solicited midway through year one and evaluated and ranked to allow funding of project awards to begin early in year two. Project budgets are expected to range from approximately $75,000-$200,000 with a duration of 1-2 years. RATIONALE: The frequency of severe storms is increasing. Additional research is needed to search for ways to minimize the damage from these storms. Additional education and outreach is needed to show Great Lakes residents and users how to take advantage of current and new information and research products.
Progress	2012 RELEVANCE: Ohio Sea Grant has a history of success in leading projects involving all Sea Grant Programs in the Great Lakes, e.g., the Great Lakes Regional Research Information Network. Ohio was asked by the other Great Lakes Sea Grant programs to lead the development of a proposal to administer a Coastal Storms Small Grant Program in the Great Lakes Region with funding from NOAA. RESPONSE: Ohio Sea Grant developed a proposal to the NOAA Coastal Storms Program to administer a small grant program in the Great Lakes Region dealing with coastal storms. RESULTS: NOAA has provided 3 years of funding totaling $1.2 million to Ohio to run the program in the Great Lakes. A coordinating committee of Sea Grant Directors has been developed. An external advisory committee and the call for proposals are being developed.
Summary	RECAP: In 2012, Ohio Sea Grant led the development of a regional proposal that was awarded $1.2 million from NOAA for a small grant program focusing on coastal storms in the Great Lakes. The call for research proposals is in development.

Program	OH
Project Title	Impacts of Climate Change on Public Health in the Great Lakes due to Harmful Algae Blooms -- Ohio Sea Grant Minibus FY2012/2013

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Investigators	Carlo DeMarchi (Case Western Reserve University (CASE)); Jay F. Martin (Ohio State University (OSU)); Jiyoung Lee (Ohio State University (OSU)); Stuart A Ludsin (Ohio State University (OSU));
Partner	Case Western Reserve University (CASE); Ohio State University (OSU);
Description	OBJECTIVES: Objective 1: Integrate an existing watershed hydrology model with relationships linking Microcystis to river discharge parameters to predict the impacts of climate change and land use on the concentration of Microcystis in Maumee Bay. Objective 2: Develop empirical models linking the concentrations of Microcystis predicted in Objective 1 to public exposure and health risk. Objective 3: Integrate results from Objectives 1 and 2 to forecast how climate and land use change will affect Microcystis and microcystin concentrations and public health in Maumee Bay. Objective 4: Disseminate research findings to relevant agencies and the general public to inform and advance adaptation and mitigation efforts. RATIONALE: The Laurentian Great Lakes provide numerous ecosystem services to user groups within the Basin. For example, during a typical year, in the Lake Erie basin, > 15 million visits are made to Lake Erie beaches, ~30 million pounds of fish are harvested from the lake, and 11 million residents consume potable water from the lake. In several of the Great Lakes (e.g., Lake Huron, Lake Michigan, Lake Ontario, and Lake Erie), however, activities such as swimming and fish consumption may now pose a serious threat to public health that is expected to increase with continued climate change, owing to the increased prevalence of harmful algal blooms (HABs), which can produce toxins such as microcystin that have been implicated in human illnesses due to liver toxicity and tumor promotion (Ohio Sea Grant 2010). Recent reports highlight that Microcystis concentrations in productive waters such as western Lake Erie regularly exceed the threshold of 20 parts per billion established by the World Health Organization (WHO) for recreational contact (e.g., LEMN 2011) and that regular consumption of walleye (Sander vitreus) from Maumee Bay, OH can result in individuals exceeding the tolerable daily intake of 2.4 ug/day of microcystin established by WHO (Poste et al. 2011). Because both Microcystis and the toxin microcystin have been shown to be positively correlated to phosphorus concentrations in Lake Erie (Rinta-Kanto et al. 2009) and phosphorus loading in western Lake Erie is strongly related to precipitation-driven inputs of total phosphorus inputs from the Maumee River (1987-2007: r = 0.84, p < 0.0001; S. Ludsin, unpub. data), the formation of HABs is likely to worsen with continued climate change. The future climate of the Great Lakes climates is predicted to have more intense rains that will transport more phosphorus downstream (Kunkel et al. 1999; Kling et al. 2003; Groisman et al 2005; Milly et al. 2005) during longer growing seasons (Kling et al. 2003; Jones et al. 2006) which will further stimulate the growth of HABs (Joseph et al. 2009; Paerl and Huisman 2009). At present, however, a major gap in knowledge exists in that there are no predictive tools capable of quantifying how HABs, microcystin production, and the threat to public health will respond to changes in climate or land use change. Such a modeling tool would greatly benefit management entities across the Great Lakes that experience seasonal HABs (e.g., Maumee Bay, Lake Erie; Saginaw Bay, Lake Huron; Muskegon Lake, Lake Michigan; Bay of Quinte, Lake Ontario) by allowing them to predict the magnitude of future health threats and determine if and what type of management may be needed to mitigate these outcomes. METHODOLOGY: Methodology 1: Climate change is

	predicted to bring a greater quantity of rainfall and more intense rainfall events leading to more runoff and increased inputs of water, sediments and nutrients to Lake Erie. This will likely lead to more phosphorus inputs and higher concentrations of Microcystis. To predict and quantify Microcystis concentrations, discharges of water, sediment, and phosphorus from the Maumee watershed to the Bay will be predicted with an existing watershed hydrology model previously developed and calibrated by C. DeMarchi. This hydrology model will be driven by land use and estimates of regional precipitation from calibrated regional climate models. We have established robust relationships between cyanobacteria and discharge of phosphorus from the Maumee River, and will use these and existing datasets as the basis for relationships linking Microcystis concentrations to river discharge variables. Linking river discharge variables with Microcystis will allow us to predict how climate and land use impact the concentrations and abundance of Microcystis in Maumee Bay. Methodology 2: Concentrations of Microcystis from Objective 1 will be used to estimate the public exposure and health risk through three pathways: (1) fish consumption, (2) water consumption and (3) recreational water contact. We will estimate fish harvest and consumption for the Maumee Bay fishery with existing harvest data for walleye (Sander vitreus) and perch (Perca flavescens). Water consumption will be based on national averages and recreational water contact will be based on surveys of beach use and boating activities. We will use existing data, and the fact that Microcsytin concentrations have been directly linked to Microcystis concentrations in Maumee Bay to predict microcystin concentrations in water based on Microcystis concentrations predicted from Objective 1. Fish concentrations of microcystin will be based on recent published data specific to Maumee Bay. Combining the three human exposure pathways with predicted microcystin concentrations in water and fish we will estimate the daily microcystin exposure (ug/day). The exposure distribution will be compared to established thresholds developed by the WHO for microcystin to derive an estimate of health risk. Methodology 3: Results from existing regional climate models will used to drive the integrated model. Public health threats from future years will then be compared with past years to see if climate change will substantially change public health due to Microcystis concentrations in Maumee Bay. Methodology 4: For a comprehensive outreach plan, we will collaborate with Ohio Sea Grant Extension Specialists, county public health agencies, and relevant state agencies.
Progress	Project initially slated to begin 2/1/2013. However, project objectives and rationale aligned with Social Science funds distributed in FY12 (NA10OAR4170074). Therefore, money was allocated to PIs in FY12, but project did not begin in FY12. Project has no been initiated, but relevance, response, results, recap (4Rs) will be reported in FY13.
Summary	See Relevance, Response, Results.

Program	OH

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Project Title	Development of a novel technique for analysis of phosphate
Investigators	Christopher Spiese (Ohio Northern University);
Partner	Ohio Northern University;
Description	OBJECTIVES: This study seeks to (1) develop and test a sensitive, high-throughput method for the quantification of dissolved phosphate (HPO42-) and (2) engage the community in a watershed-wide sampling and analysis of dissolved phosphate. From these goals, several deliverable items will be created. First and foremost, a published method in a peer-reviewed scientific journal will be evidence that goal 1 has been accomplished. The second major deliverable is a data set that will quantify the phosphorus content in the Blanchard River and its major subwatersheds. RATIONALE: Phosphorus loading is a critical issue for many of the Great Lakes watersheds. Elevated levels of phosphorus, particularly dissolved phosphorus, can lead to eutrophication, algal blooms, and eventually the formation of "dead zones" where dissolved oxygen levels drop below what is required to support aquatic life. Given the large number of watersheds and bodies of water facing problems related to phosphorus pollution, the cost of analysis and the relatively long analysis times associated with measuring the various forms of phosphorus can be a hurdle preventing effective ecosystem management. An ideal method for phosphorus analysis should have (1) inexpensive, stable reagents, (2) short analysis times, (3) low interferences from other ions, (4) low toxicity from reagents, and (5) simple analytical techniques. The development of novel techniques that overcome these barriers is ideal for permitting wider analysis of dissolved nutrients. Fluorescent techniques offer lower limits of detection versus colorimetric, as well as permitting easier adaptation to high-throughput methods such as microplate analyses. Use of the fluorophore to be tested in this study will be a major step toward improving sampling and analysis for dissolved phosphate. METHODOLOGY: In order to develop a rapid and sensitive test for dissolved phosphate, a novel fluorimetric technique will be employed. This study will determine its suitability for freshwater systems, with particular attention to potential interferences from silicate, arsenate, and carbonate, as well as organic acids. As part of this testing procedure, samples will be collected from the entire Blanchard River watershed by volunteers and local high schools. The method will be then used to analyze those samples and compared to the colorimetric technique (EPA method 365.3).
Progress	2012 RELEVANCE: This study sought to develop a faster, easier method for determining dissolved P levels in freshwaters. RESPONSE: A Sea Grant-funded researcher was able to develop a fluorescent compound that responds to phosphate. This method was checked against potential interferences and is nearly complete. RECAP: The method is nearly finished testing. This method has the potential to become a standard technique for P analysis, and may benefit analytical labs and community groups testing for dissolved P.
Summary	RECAP: In 2012, a new method was successfully developed for dissolved P analysis in freshwater, and has the potential

	for deployment as a front-line technique.

Program	OR
Project Title	An Integrated Engineering-Economic Vulnerability Assessment Tool to Increase Tsunami Preparedness in Rural Coastal Counties
Investigators	Chen, Yong (Oregon State University (OSU));
Partner	
Description	Objectives The overall objective of this project is to reduce economic vulnerability and increase preparedness of rural communities for tsunami events. Achieving this objective will make rural places more resilient to tsunamis. The objective will be achieved by answering two research questions and involving community leaders in deliberations about tsunami vulnerability and preparedness actions: 1) How economically vulnerable is Clatsop County to a major tsunami event? 2) What is the likely impact of various preparedness strategies on the vulnerability to tsunamis of the Clatsop County economy? Methodology This project develops an innovative tool for estimating economic vulnerability inside and outside the inundation zone that has broad applicability for enhancing the resilience of vulnerable rural coastal communities and regions. We briefly introduce the five related components of this project and discuss each of these components in more detail in subsequent sections. (1)CSZ Tsunami Event Model: We will develop a spatially explicit CSZ event physical damage model to predict the extent and spatial distribution of the physical damage from a tsunami for Clatsop County in Oregon, using parcel-level building structure data. (2)Multi-regional Inoperability Input-output Model: We will construct a multi-regional inoperability inputoutput model (MRIIM) of Clatsop County that traces out the impact of this damage toeconomically linked industries inside and outside the inundation zone. (3)Integrated Vulnerability Assessment Tool: We will integrate the spatially explicit Tsunami Event Model (component 1) with the multi-regional input-output economic model (component 2) to create an Integrated Vulnerability Assessment Tool (IVAT) that can estimate the economic vulnerability both inside and outside of the tsunami inundation zone. (4)Local Engagement: We will engage local business, governmental and civic leaders in a structured process to (incorporate local knowledge into the parameters and assumptions of the Tsunami event model, the MRIIM and the IVAT. We will re-engage local community leaders in a structured process that will use the interactive Integrated Vulnerability Assessment Tool to simulate how implementation of locally defined preparedness ideas (both public and private) would reduce economic vulnerability in Clatsop County. (5)Outreach: All the project components will be shared with economic

	development professionals and emergency management officials at the local, state and federal levels to assist them in planning,emergency management and economic development. Rationale Many coastal Oregon communities are at risk to significant devastation and loss of life from a major Cascadia Subduction Zone (CSZ) earthquake and the resulting tsunami. The likelihood of a major CSZ event has been estimated at 14% in the next 50 years (USGS, 2005) with recent research suggesting that the probability is much higher. Given the extreme nature of the hazard with extensive inundation affecting local economies throughout the Pacific Northwest, it is critical that coastal communities develop preparedness strategies for reducing the economic vulnerability to tsunamis and to improve community resilience after an earthquake/tsunami event. Models exist to predict the extent of the tsunami inundation and have been used to develop evacuation strategies to reduce the casualty losses. However, there has been little effort to extend the inundation to economic consequences. This project will couple, for the first time, a tsunami event model to assess the damage to infrastructure affecting several economic sectors with a multi-regional input-output economic model to assess the economic vulnerability at the county level. This project will be the first to link an engineering event model using fragility modeling of tsunamis with a spatially explicit multiregional inoperability input-output model into an integrated vulnerability assessment model of tsunamis. It will be the first to use an understanding of sectoral interdependence across space to link physical damage in an inundation zone to economic loss in both the inundation zone and the surrounding regional economy. It will be the first to develop an inoperability input-output model at the county scale and to apply it in the analysis of a natural disaster in a remote rural region.This project has extensive community engagement to tie key components together and develop a useful tool to engage in the central question of "what we wish we had done" to prepare for the CSZ event. Expected Outcomes There are three sets of outcomes desired in this project: (1) Outcomes for the science of disaster impact assessment. The research community will have new tools and frameworks for assessing disaster impacts, particularly of tsunamis: (a) a new spatially-explicit tsunami event modeling framework that extends current practice by introducing fragility modeling for tsunamis; (b) an economic impact framework that extends current spatially-explicit multiregional inoperability input-output for use at a county-level scale predicting impacts both inside the tsunami inundation zone and in the rest of the county economy; and (c) an integrated tsunami vulnerability assessment tool that links the event model with a multiregional inoperability input-output model to allow simulation of spatially explicit economic damage estimates inside and outside the tsunami inundation zone under different tsunami intensity scenarios and different preparedness action scenarios. (2) Outcomes for policy design. State and national policymakers will be able to design emergency management strategies with a fuller understanding of the spatial extent of both physical and economic damages from tsunamis. (3) Outcomes for Clatsop County: Local government and business leaders will better understand their economic vulnerability to tsunamis and the geographic extent of both physical damages and economic damages. They will also have a tool and a structured process for analysis of actions they could take (such as land use actions and infrastructure investments) to make the county economy less vulnerable to a tsunami and more resilient when tsunami occurs.
Progress	

Summary	

Program	OR
Project Title	Successful Adaptation: Identifying Effective Process and Outcome Characteristics and Practice-Relevant Metrics
Investigators	Gosnell, Hannah (Oregon State University (OSU));
Partner	
Description	Objectives What is successful adaptation to climate change in the coastal context? This is a question we are frequently asked by practitioners, yet one that has no easy scientific or political answers. While adaptation is increasingly recognized as an important climate risk management strategy, and on-the-ground adaptation planning activity is beginning to emerge everywhere, resource managers and planners have no clear guidance as to what success would look like. Success raises vexing management challenges and complex scientific questions about how to identify desirable outcomes and mechanisms across spatial/temporal scales, ecological systems, and social strata. Our project will address these questions by engaging scientists and coastal practitioners in an iterative, collaborative exploration of adaptation outcomes, processes and mechanisms, and the metrics with which to measure success in coastal communities in California, Oregon and Washington. The proposed project will contribute to Sea Grant's cross-cutting goals by integrating multi-disciplinary scientific and practitioner expertise to facilitate social learning and improve the management of coastal human-natural systems under rapidly changing conditions. We believe that makes this project exemplary of Sea Grants guiding principles applied toward one of its core research and management priorities. Managing the impacts of climate change and sea-level rise on coastal resources is a major concern in all three states; this work will assist the states in their efforts to develop regionally-integrated and locally appropriate state-based adaptation strategies, as well as provide needed guidance for local coastal practitioners across the region. The project will not only answer a pressing fundamental and use-inspired science question for the coastal sector, but contribute to regional management priorities and the national, multi-sector assessment and capacity-building effort of the Third National Climate Assessment. Methodology We aim to develop guidance for coastal practitioners on the characteristics of successful adaptation to climate change in the coastal environment, in terms of (1) outcomes and (2)

processes, governance and social mechanisms. We will use literature and policy reviews, interviews, and workshops with both scientists and practitioners, separately and combined – to create scientifically-grounded, practice-relevant indicators and metrics of success in both categories. Reviews of scientific literature on such topics as climate change adaptation, coastal hazards, resilience, and integrated coastal zone management, and of planning and policy documents related to adaptation, coastal hazards management, and disaster risk reduction will provide a foundational synthesis of current thinking that will be expanded, augmented, and ground-truthed by project participants. Workshop participants will work towards a common understanding of desirable adaptation outcomes, while explicitly addressing some of the most persistent, vexing challenges of coastal zone management (e.g., public vs. private rights and responsibilities; ecological vs. human needs; near- vs. longer-term objectives). The resultant contradictions and conflicts raise the question of successful institutional, policy and social mechanisms that allow for adjudication, compensation and acceptance, as well as process questions on how to conduct adaptation planning and decision-making to minimize anticipated conflicts. Qualitative analysis of discussions will use the conceptual adaptation frameworks of Eakin et al. (2009) and Pelling (2011) to assess how the characteristics of successful adaptation identified by scientists and practitioners are influenced by their interpretations of adaptation. Policy-relevance and policy-application will be insured by careful participant selection and engagement of project personnel in regional policy, planning, training and outreach processes before, during, and after the project.   Rationale Climate change will have widespread environmental, economic and social impacts, forcing coastal communities to face difficult choices and trade-offs in the decades ahead. Managing the impacts of climate change and sea-level rise on coastal resources is a major concern in all three West Coast states; state agencies and governors have publicly acknowledged the need for adaptation and begun to develop strategies to manage the effects of climate change, as have many local, tribal and federal entities. In this context, practitioners increasingly ask one big and difficult question: What would successful adaptation to climate change look like? Arguably, rather little has been said to date that would satisfactorily answer it. We aim to develop some answers through the iterative engagement of scientists and practitioners, and share them with those asking these questions across the West Coast and the nation. These answers are essential for the success of existing and future adaptation efforts at the local to national scales, and for the success of Sea Grant's core vision of people living along our coasts in harmony with the natural resources that attracted and sustain them. The proposed qualitative, multi-stage approach is reflective of the early state of understanding of adaptation success and of our commitment to policy-relevant science. It draws on existing knowledge, resting in science, policy documents, and in the experience of coastal practitioners to produce results, including a sophisticated articulation of what types of outcomes and process characteristics would be desirable (generically, or for particular stakeholders), and why; guiding principles on evaluating adaptation options; and practical success metrics. Project beneficiaries include regional policymakers, coastal practitioners and stakeholders; national coastal stakeholders and adaptation professionals; local, state, federal and tribal policymakers; National Climate Assessment and other adaptation groups.   Expected Outcomes The proposed project will contribute to Sea Grant's cross-cutting goals by integrating multi-disciplinary scientific and practitioner

	expertise to facilitate social learning and improve the management of coastal human-natural systems under rapidly changing conditions. It will achieve this overarching and several more specific results through the literature reviews, interviews, research workshops and subsequent analysis and synthesis, and the extensive engagement activities with scientists and practitioners in and after the workshops. We believe that makes this project exemplary of Sea Grants guiding principles applied toward a core research and management priority. Specific results of the proposed work include: a clear categorization of "desirable" and undesirable" outcomes of coastal climate adaptation actions; a sophisticated articulation of what types of outcomes and process characteristics would be desirable, and why, to justify the label "success"; a set of guiding principles on how to assess adaptation options as to their traits, desirability, and potential trade-offs; a set of practical success metrics (some of which might be existing performance measures in different management regimes, others are not but could be established to encourage successful adaptation). In light of the growing pressure from climate change on coastal areas, the voiced need for such principles and metrics of adaptation success, and their non-existence to date in either guidance or plans, we believe this project will begin to fill a critical gap in the scientific literature and management practice. Each of these outcomes is grounded in current scientific thinking and co-created with practitioners to be practice-relevant. Specific project outputs around these results include focused learning and networking opportunities; peer-reviewed articles; derived communications via various print, digital, and conference venues; and extensive outreach activities.
Progress	UPDATE: 2012 was the first year of this effort. One OSG project is focused on developing effective Direct Marketing Approaches (DMA) for commercial fisheries. The DMA team has an overarching goal of identifying and evaluating patterns, processes, and impacts associated with DMAs. The project has developed an advisory committee, identified interviewees, and developed the interview instrument, commencing in late 2012. They have profiled existing DMAs, with the end goal of integrating this knowledge into practical tools for use by west coast communities and others in DMA decision-making. The adaptation project aims to examine what characterizes "successful" adaptation to climate change – in terms of both process and outcomes – in the context of coastal communities on the west coast. This team planned and successfully executed a highly interactive two-day workshop with 20 scientists in October, 2012. Based on feedback received, post-workshop reflections, and overarching project goals, planning for three practitioner workshops is now underway. Each will similarly aim to entrain a diverse cross-section of the leaders in coastal adaptation in each state, with representation across levels of governance and across the geography of the state. Those workshops are expected to occur in 2013. In addition, a white paper was developed as background information for that workshop, identifying existing (and missing) dimensions and criteria for successful adaptation to climate change via a review of the relevant scientific and gray literature. This white paper is currently being reworked for publication in a peer-reviewed journal. Original Impact ID 15482 (2011): RELEVANCE: Encompassing the shorelines, estuaries, and offshore ocean environments from Washington to California, west coast marine and coastal ecosystems are diverse and rapidly changing. Expanding pressures from population growth, changing land use, and large-scale environmental shifts affect the natural resources and biogeochemical processes that sustain coastal ecosystems and the communities, businesses,

	and people that rely upon them. OSG recognizes the importance of social science research while at the same time strengthening partnerships with West Coast Sea Grant Programs to improve coordination, collaboration, and advancement of regional priorities. RESPONSE: The four west coast Sea Grant programs collectively made available $700,000 over two years to fund projects of regional interest targeting social science questions aligned with the national Sea Grant goals of healthy coastal ecosystems; sustainable coastal development; a safe, sustainable seafood supply; and hazard-resilient coastal communities. RESULTS: Two projects were funded by this West Coast Regional program that have direct connections to Oregon researchers. One project is a study of seafood direct marketing approaches to increase resilience and sustainability of community-supported fisheries, with an emphasis on helping fishermen learn about direct marketing and identify appropriate approaches for local fisheries and consumer base. The other project supports a series of workshops with community managers and adaptation practitioners. Workshop goals include reaching a common understanding of desirable adaptation outcomes, while explicitly addressing some of the most persistent challenges of coastal zone management (e.g., public vs. private rights and responsibilities; ecological vs. human needs; near- vs. longer-term objectives). RECAP: Sea Grant is committed to advancing research into social science issues relevant to west coast stakeholders.
Summary	Sea Grant is committed to advancing research into social science issues relevant to west coast stakeholders, such as adaptation to climate change and direct seafood markets.

Program	OR
Project Title	Assessing the Socio-Political Context of Disaster Recovery in Coastal Oregon
Investigators	Cramer, Lori (Oregon State University (OSU));
Partner	
Description	Obectives The goal of this study is to utilize a socio-political capital framework to contextualize the decision-making boundaries of stakeholders based on an inventory of assets. The level of resources, participation, knowledge, support, and legitimate power all contribute to an organization's decisionmaking capacity. Under normal circumstances dominance fluctuates between a few established groups, but in a disaster there is the potential for new groups to emerge and wield the power of popular opinion. This discourse can invoke change in a positive or negative way. A better understanding of the established socio-political networks can be utilized to understand how these new groups emerge

	and work among other stakeholders in the event of a disaster when physical and social infrastructure is compromised. The goal of this research is to enhance these socio-political assets, endowing stakeholders with knowledge of their orientation among others. Focused research efforts and product development on the role of political and social capital in coastal community recovery to natural hazards will improve the ability of communities to recover from extreme natural events through collaboration. Specific Objectives: 1) Identify socio-political networks through which various disaster management agencies (both formal government and informal community) communicate, acquire resources and interact with community groups; 2) quantify and analyze connections and communication strategies between socio-political networks, with particular attention to communication outreach to vulnerable groups (to build on the recent work of the PI); and 3) identify opportunities for improving communication, enhancing participation by diverse stakeholders, and strengthening community resilience. Rationale Recent research suggests that successful preparedness and recovery efforts recognize the importance of community socio-political networks, but we know little about the presence or absence of such network systems along the Oregon coast. Examining the socio-political context of Oregon coastal communities offers a unique opportunity to investigate the efficacy of social and political capital as it relates to community disaster planning efforts prior to a disaster. Our proposed project offers a necessary empirical and applied extension to an increasingly relevant body of literature that emphasize adaptive-capacity behavior, community function and competence, societal and political context, social vulnerability and community resilience. The socio-political network analysis from this study will provide a description of the context couching the decision making processes of agency/community personnel responsible for disaster recovery. Results will then be used to identify areas of socio-political strengths, weaknesses, and opportunities for improvement. This information will help us target education and outreach activities to specific networks of local residents, who, based on preliminary work by the PI, may need assistance in knowing what entities to contact regarding education, preparedness, and training.
Progress	
Summary	

Program	PA
Project Title	Helping a Tidal Riverfront Community Build Capacity to Adapt to Climate Change (Chester, PA)
Investigators	Ann Faulds (Penn State Behrend (PSU));

Partner	
Description	Chester, Pennsylvania, located near Philadelphia and just ten miles northeast of Wilmington, DE, is a financially distressed community that is particularly susceptible to the impacts of climate change. Increased storms, sea level rise and extreme heat will affect Chester populations that are already vulnerable due to poverty, lack of services, and other social and economic stressors. The City of Chester also needs to protect resources that will be critical to its revitalization, such as property along the city's waterfront that has potential for redevelopment. Chester's once nearly abandoned waterfront now features class A office space, entertainment destinations, and public access along the Delaware River. Continuing this waterfront redevelopment is important, so it is crucial for the City to find ways to protect existing resources from the impacts of climate change, while also identifying ways to enable future development that will be resilient to anticipated changes. A coalition of planners and coastal outreach specialists from Pennsylvania Sea Grant and their project partners will team up with community stakeholders to identify how climate change can exacerbate "on-going" problems facing Chester, such as water availability, sewage treatment and storm water management, while showing how climate change can intensify extreme weather events. This two-year project will bring the best available data, resources, and information to help the Chester community make informed decisions and implement adaptation strategies.
Progress	
Summary	

Program	PA
Project Title	Pennsylvania Sea Grant Climate Adaptation (2012-14)
Investigators	Robert Light, Ph.D. (Penn State Behrend (PSU));
Partner	
Description	City of Erie Coastal Community: A comprehensive strategy for climate change adaptation does not currently exist for the

	City of Erie, one of Pennsylvania's significant coastal communities. This project aims to convene key decision makers and municipal officials in the City of Erie, together with climate adaptation experts and resources, to facilitate climate adaptation planning on the city level. Pennsylvania Sea Grant proposes to host an 8-hour workshop on climate adaptation planning focused on the City of Erie, Pennsylvania. This workshop will utilize the "Climate Ready Great Lakes" modules developed by the NOAA Great Lakes regional team drawing mainly from Module 2, which guides users through an overview of the climate adaptation planning process, assesses vulnerabilities and opportunities, and identifies specific adaptation strategies. A major goal of the Erie City engagement process will be to include key decision makers and municipal staff and officials in the planning process. Delaware County Coastal Communities: Pennsylvania requests Climate Adaptation funds to further engage coastal municipalities in Delaware County, Pa in assessing and planning for climate hazards. We propose to build upon the work begun at the 2010 Roadmap to Planning for Coastal Risk workshop where we worked with a number of municipalities in Delaware County. The facilitated planning process will further engage three of the following waterfront communities: Eddystone, Marcus Hook, Tinicum, Norwood, Folcroft, and Ridley. Over a two year period, we will take the recommendations of the 2010 Roadmap workshop and develop three localized workshops for participating municipalities so that it's convenient for decision makers and community members to attend. To further enhance the effectiveness of our workshops and more fully engage our audience, PASG will utilize Texas Sea Grant's weTable interactive, multimodal tools to enhance climate adaptation understanding and planning for coastal Pennsylvania.
Progress	
Summary	

Program	PR
Project Title	Climate change adaptation capacity building initiative
Investigators	
Partner	National Park Service (US DOI, NPS); Puerto Rico Department of Natural and Environmental Resources; Puerto Rico Environmental Quality Board; Puerto Rico Health Department;
Description	OBJECTIVES: To provide coastal communities with sufficient information to consider alternatives, enable them to make

	better informed decisions, and ultimately develop and implement customized solutions to the hazards and climate change challenges which threaten their economic, environmental, and social well-being. And coastal citizens, NGOs, government agencies, trade organizations, and industries that recognize the complex inter relationships between social, economic and environmental values in coastal areas and work together to balance multiple uses and optimize environmental sustainability. METHODOLOGY: Field observations and at least nine focus groups in coastal communities in the Municipalities of Cabo Rojo, Añasco, Aguada, Rincón, and Aguadilla will be conducted to determine the knowledge about coastal vulnerability, hazards and resiliency capacity. Present a report on the results and recommendations from the focus groups and field observations to elected officials, legislators, and representatives of the west coast. Begin the development of action plans to attend priority issues on vulnerability and resiliency of these communities. Develop a document of Public Policy Guidelines for Climate Change Adaptation in Puerto Rico. The development of this document will include interviews to 10 local stakeholders on climate change adaptation in Puerto Rico, three meetings with decision makers to provide their input and recommendations to the draft and final document. Presentation of the final document to legislators and representatives of the Government of Puerto Rico and encourage them to adopt these guidelines to attend climate change adaptation issues in the island. RATIONALE: Islands are uniquely vulnerable to many of the potential consequences of climate change. It's important that residents of coastal communities understand the risks of climate change and learn what they can do to reduce their vulnerability and response quickly and effectively when the events occur. This will be achieved following the recommendations of the Strategic and Implementation plans. BENEFITS: Coastal decision-makers have the knowledge and skills to assess local risk vulnerability and respond with appropriate policies and regulations. Coastal opinion leaders and decision-makers take proactive measures to ensure that hazards, risks, and vulnerabilities are communicated to property owners and prospective purchasers. Coastal residents and decision makers are aware of and understand the physical processes that produce hazards and climate change and the implications of those events for their communities. Coastal decision makers are knowledgeable of the tools and practices to mitigate the impacts of hazards and climate change and the implications, and implement strategies for their mitigation.
Progress	Relevance: The west coast of Puerto Rico comprises the municipalities of Mayagüez, Cabo Rojo, Añasco, Rincón, Aguada and Aguadilla. Most of the residents of these municipalities are settled on coastal areas, including those of several communities that historically established on beaches, wetlands and river basins and others that are migrating to the coast, attracted by the coastal natural attractions and economic and recreational opportunities. Little is known about the capacity of these coastal dwellers to take deliberate actions to reduce risk from coastal hazards in order to avoid disaster or to accelerate recovery in the event of a hurricane, earthquake, flood or tsunami. Response: Current efforts of this project integrated these five municipalities to consolidate a framework for community based programs and disaster management. A total of fifteen coastal communities are currently participating in the project. Efforts are aimed to enhance their resiliency capacities in the areas of community development, coastal management and disaster management. Our team held three (3) focus groups to gather information about the communities and conducted over

	100 individual interviews with residents. Participants provided information about their knowledge and practices regarding socioeconomic and cultural conditions for resilience (old and sick residents, disabled persons, poor, religious), human uses of coastal resources in order to maintain environmental and ecosystem resilience (fishing villages, ports, marinas, airports) and preparedness, response, recovery and mitigation to reduce human and structural losses from coastal hazards (tsunamis, hurricanes, storm surge) and their response actions (evacuation routes, infrastructure and home safety protocols). Results: Participants identified the following issues as points of concern: climate change, natural hazards and their resilience capacity. Specifically they now understand and are aware of hazards and know where to look for risk information to make appropriate decisions. Two of the communities are capable of receiving notifications and alerts of coastal hazards, reducing the impact of at risk population (old and sick). Efforts were made to establish and maintain mechanisms and networks to respond quickly to coastal disasters and address emergency needs at the community level. It was evident that plans to accelerate disaster recovery from hazard events are not in place and that communities need to be engaged in the recovery process in order to minimize negative environmental, social, and economic impacts. As part of this effort we coordinated a workshop at the UPR in Mayagüez where all the government agencies with responsibilities regarding emergency management for natural hazards were present and community leaders presented their communities (population, location, average age of residents, disadvantage populations), situations, problems, opportunities, needs and concerns and the agencies offered information about their responsibilities, services offered capabilities, contact information and willingness to collaborate with the communities. One important point brought by the agencies was that it is a big advantage to be able to meet with the communities out of an emergency, make connections, establish channels of communication and discuss problems beforehand with time to solve the problems. Municipal and insular governments need to evaluate the relocation of some of these communities. Educational programs and outreach services from local and state agencies were also identified as a priority in order to conjointly develop future plans regarding relocation and evacuation routes based on their different needs and the socioeconomic and cultural characteristics of their respective communities.
Summary	UPR Sea Grant promotes and encourages coastal communities' residents to develop an education and outreach agenda on climate change adaptation, coastal hazards, and guidelines to develop resilient coastal communities.

Program	PR
Project Title	Climate change adaptation capacity building initiative
Investigators	

Partner	National Park Service (US DOI, NPS); Puerto Rico Department of Natural and Environmental Resources; Puerto Rico Environmental Quality Board; Puerto Rico Health Department;
Description	OBJECTIVES: To provide coastal communities with sufficient information to consider alternatives, enable them to make better informed decisions, and ultimately develop and implement customized solutions to the hazards and climate change challenges which threaten their economic, environmental, and social well-being. And coastal citizens, NGOs, government agencies, trade organizations, and industries that recognize the complex inter relationships between social, economic and environmental values in coastal areas and work together to balance multiple uses and optimize environmental sustainability. METHODOLOGY: Field observations and at least nine focus groups in coastal communities in the Municipalities of Cabo Rojo, Añasco, Aguada, Rincón, and Aguadilla will be conducted to determine the knowledge about coastal vulnerability, hazards and resiliency capacity. Present a report on the results and recommendations from the focus groups and field observations to elected officials, legislators, and representatives of the west coast. Begin the development of action plans to attend priority issues on vulnerability and resiliency of these communities. Develop a document of Public Policy Guidelines for Climate Change Adaptation in Puerto Rico. The development of this document will include interviews to 10 local stakeholders on climate change adaptation in Puerto Rico, three meetings with decision makers to provide their input and recommendations to the draft and final document. Presentation of the final document to legislators and representatives of the Government of Puerto Rico and encourage them to adopt these guidelines to attend climate change adaptation issues in the island. RATIONALE: Islands are uniquely vulnerable to many of the potential consequences of climate change. It's important that residents of coastal communities understand the risks of climate change and learn what they can do to reduce their vulnerability and response quickly and effectively when the events occur. This will be achieved following the recommendations of the Strategic and Implementation plans. BENEFITS: Coastal decision-makers have the knowledge and skills to assess local risk vulnerability and respond with appropriate policies and regulations. Coastal opinion leaders and decision-makers take proactive measures to ensure that hazards, risks, and vulnerabilities are communicated to property owners and prospective purchasers. Coastal residents and decision makers are aware of and understand the physical processes that produce hazards and climate change and the implications of those events for their communities. Coastal decision makers are knowledgeable of the tools and practices to mitigate the impacts of hazards and climate change and the implications, and implement strategies for their mitigation.
Progress	Relevance: This effort established a dialog with experts from different academic disciplines to generate recommendations for a climate change adaptation public policy for Puerto Rico. Response: A roundtable of twenty-seven (27) experts on the fields of planning, economy, environmental sociology, agriculture, biology, ecology, engineering and the insurance sector participated in this process. Results: As a result of Sea Grant's effort and leadership a meeting with the President of the Puerto Rico Planning Board has been scheduled for June 6, to present the climate change and coastal hazards adaptation recommendations to be adopted by the Puerto Rico Land Use Plan to be

	completed by October of 2013. A draft document with the recommendations has been completed and is under review by the panel of experts. This document will be presented to the Puerto Rico Planning Board, the Department of Natural and Environmental Resources, the Puerto Rico Senate and the House of Representatives, to be considered and adopted as the Climate Change Adaptation Public Policy for Puerto Rico.
Summary	Sea Grant Puerto Rico is a respected leader in climate change and coastal hazards adaptation strategies for Puerto Rico and is in a very good position to establish the Public Policy for Climate Change and Coastal Hazards Adaptation in Puerto Rico.

Program	PR
Project Title	Development of the Puerto Rico Beach and Surfzone Currents Warning System
Investigators	Julio Morell (University Of Puerto Rico, Mayaguez (UPR)); Miguel Canals (University Of Puerto Rico, Mayaguez (UPR));
Partner	University Of Puerto Rico, Mayaguez (UPR);
Description	OBJECTIVES: The investigators seek to develop a warning system which will combine numerical modeling, empirical knowledge, field observations and custom website development to better educate the public on the hazards of wave-induced currents in Puerto Rico. The specific objectives are to develop a custom website for real-time beach safety related information and to develop customized hazardous current warning signs for the deadliest beaches in Puerto Rico. METHODOLOGY: These objectives will be achieved by leveraging resources from the Caribbean Coastal Ocean Observing System's ocean observing assets and computational infrastructure with the support obtained from the present proposal. A customized webpage will be designed to provide beach-specific estimates of the hazard posed by dangerous currents on any given day. The website will be based on a beach hazard matrix to be developed for each of the four major coasts of Puerto Rico, taking into account local wave climate, wave sheltering, coupled wave and wind effects and local bathymetric effects for each major beach. In addition, customized hazardous currents warning signs will be developed for the island's deadliest beaches based on the results of numerical simulations and field observations. The methodology for this approach was developed as part of a successful pilot project carried out by the investigators at Jobos Beach, the deadliest beach for swimmers in Puerto Rico. RATIONALE: It is well known that the main factor leading to drowning deaths in Puerto Rico are wave-induced currents and the lack of education of the public on the topic of beach hazards. The investigators propose to develop the "Puerto Rico Beach and Surfzone Currents

	Warning System" in an effort to provide the public with potentially life-saving information on hazardous beach conditions.
Progress	The first objective has been met. With the assistance of the Puerto Rico Department of Natural Resources 44 beaches were selected. The second and third objectives are at an advanced stage. Data related to boundary conditions for the 2D Boussinesq model have been obtained. High resolution bathymetry, wind and wave conditions have been incorporated into the model for some of the most important beaches. The model has been run and compared with field measurements with good results. The development of the beach safety website which will reside at www.caricoos.org/drupal/beachsafety has begun, and an initial version will provide point forecasts of wave height, wave direction and wind conditions for each dangerous beach in Puerto Rico. This information will then serve as input to the beach hazard matrix (objectives 4, 5 and 6).
Summary	

Program	PR
Project Title	Understanding it better: Landscape transformation and vulnerability to coastal hazards in Puerto Rico
Investigators	Tania Lopez-Marrero (Rutgers University);
Partner	
Description	The overall objective of the proposed research is to analyze community vulnerability to coastal hazards and their amplifiers –including floods, earthquake and liquefaction, and tsunamis– in the northern portions of the coastal municipalities of San Juan, Carolina, and Loíza in Puerto Rico. The vulnerability analysis will take into account landscape transformations and urban/built-up expansion in hazard-prone areas, along with an assessment of communities and concerned government officials' knowledge and understanding of hazards exposure and the processes influencing vulnerability to such hazards in the study area, including adaptation options. A second objective of the project consists in developing a website that will contain information about coastal communities exposure to hazards in the study area and that will also provide resources to promote a better understanding about the interrelations of landscape transformations and urban/built-up expansion to hazard exposure and vulnerabilities. Ultimately, the goal is to provide information and tools so that people can better plan and act upon the potential occurrence of natural hazards. The

	research will be conducted in collaboration with the Puerto Rican Non-Govenmental Organization Instituto de Ciencias para la Conservación de Puerto Rico.
Progress	
Summary	

Program	RI
Project Title	Coastal Community Development (CCD)
Investigators	Jennifer McCann (University of Rhode Island, Coastal Resources Center (URI));
Partner	City of Newport, RI; National Estuarine Research Reserve System (US DOC, NOAA, NOS, NERRS); Rhode Island Division of Planning; Rhode Island Emergency Management Agency; Rhode Island Climate Commission; Rhode Island Coastal Resources Management Council (
Description	Objectives: The objectives are to provide the City of Newport with a sea level rise vulnerability assessment and climate change adaptation tools and to provide technical assistance and climate change science information to the state and the municipalities. Methodology: Our methodology for both objectives is to work with researchers to ensure we are equipped with the best and most current climate change science and then to communicate this research and its implications to the state and municipalities so they can make informed decisions about incorporating climate change adaptation measures into guiding policy documents. Rationale: We have been asked by the state and communities to provide this support because: 1) It is difficult for decision-makers to determine on their own which climate change information is correct and should serve as a basis of policy making; and 2) There is little capability currently available to governments, either state or local, which would enable them to produce and develop elevation map and data products, to assess vulnerability and prioritize risks, and to implement appropriate state policies and programs tailored to their specific needs. We have carried out these efforts for the Town of North Kingstown and the South Kingstown Land Trust, and we are now starting this work with the City of Newport, which is already investing in waterfront redevelopment efforts and needs to incorporate climate change science and policymaking into the initiative to make it viable for the long term. With additional funds, we would likely be able to start work with the Town of Narragansett as well and hire a graduate student to support the project and gain a learning opportunity.

Progress	RELEVANCE: The ability for graduate students to engage with professionals in a real world setting provides the opportunity to grow through experiential learning. One mechanism to promote and foster such engagement is a fellowship. RESPONSE: In collaboration with the University of Rhode Island Department of Marine Affairs, Rhode Island Sea Grant established the Sea Grant Marine Affairs Fellowship which provides tuition and stipend support for select Master's level graduate students. RESULTS: Clara Ruben, the first Sea Grant Marine Affairs Fellow, who began her fellowship fall semester 2011, presented her thesis research efforts on sea level rise adaptation through local land trusts at The Coastal Society 23rd International Conference in Miami, FL, during June 2012. Her presentation was presented an award from Best Student Presentation given at the conference.
Summary	The first Sea Grant Marine Affairs Fellow, Clara Ruben, presented her thesis research on using local land trusts to achieve sea level rise adaptation measures, won Best Student Presentation at The Coastal Society 23rd International Conference in June 2012

Program	RI
Project Title	Enhancing Sea Grant's ability to help coastal communities adapt to climate change.
Investigators	Pamela Rubinoff (University of Rhode Island, Coastal Resources Center (URI));
Partner	City of Newport, RI; National Estuarine Research Reserve System (US DOC, NOAA, NOS, NERRS); Rhode Island Emergency Management Agency; Rhode Island Climate Commission; Rhode Island Coastal Resources Management Council (RI CRMC); Rhode Island Division of P
Description	Objectives: The objective is to build upon the Climate Change Collaborative research achieved during its first two years and test communication tools upon a Rhode Island municipality. Methodology: This work would be tested out in the Rhode Island coastal community of Newport, as it is an existing climate change adaptation project site for CRC/SG. In 2012, we will work with the city and community members to collect and analyze data, create a series of detailed sea level rise maps, and provide workshops and forums for open dialogue regarding solutions and adaptations to climate change impacts. With enhancement funds for the Climate Change Collaborative, we will be able to develop specific communication tools that message to people who are at different phases of believing in climate change. Rationale: We have been asked by the state and communities to provide this support because: 1) It is difficult for decision-makers to determine on their own which climate change information is correct and should serve as a basis of policy making; and 2) There is little capability currently available to governments, either state or local, which would enable them to produce

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Program	RI
Project Title	REGIONAL CONSORTIUM PROJECT -- Climate change adaptation and ecosystem service resilience in Northeast coastal communities: quantifying economic values and tradeoffs for regional decision support.
Investigators	
Partner	Clark University; The Nature Conservancy (TNC);
Description	OBJECTIVES: The proposed project will coordinate natural and social science data to quantify economic benefits, costs and tradeoffs related to climate change adaptation, ecosystem service resilience, and adaptation outcomes in Northeast coastal communities. Results will be sued to evaluate and communicate economic consequences of adaptation strategies. Objectives include: (1) building upon natural and socioeconomic data in the extant Coastal Resilience

	platform, adapt economic frameworks developed to quantify ecosystem service values for application to coastal hazard adaptation in pilot communities; (2) coordinate biogeophysical data with choice experiment modeling to quantify benefits/costs related to changes in ecosystem services and other outcomes realized by the public under alternative scenarios; (3) evaluate implications for adaptation benefits/costs and test hypotheses on: (i) the magnitude of ecosystem service values, (ii) links to biogeophysical conditions, and (iii) differences across communities and implications for regional adaptation; (4) coordinate with partners on communication and extension to inform local/regional adaptation. METHODOLOGY: The project will adapt established valuation frameworks to biogeophysical and socioeconomic data within Coastal Resilience (www.coastalresilience.org), reflecting adaptation scenarios in pilot communities of Old Saybrook (CT), Gilford (CT) and Southold (NY). Grounded in these scenarios and data, economic values will be estimated using survey-based choice experiments that quantify values and tradeoffs for ecosystem services and other natural/socioeconomic outcomes, revealed through households' voting choices over multi-attribute adaptation alternatives. Combined with data on adaptation costs, results will provide a comprehensive perspective on economic benefits, costs and tradeoffs of adaptation scenarios, including effects on ecosystem service values. Results from multistate pilot communities will be combined to assess implications for local and regional adaptation, with hypothesis tests distinguishing between community-specific versus regionally-transferable patterns. Combined with workshops, engagement, and communication leveraging multiple partners, the project will provide a practical, regional perspective on economic consequences of adaptation options and ecosystem service resilience in Northeast coastal communities. RATIONALE: Northeast UR coastal communities are increasingly vulnerable to hazards from a variable and changing climate, include sea level rise and increasing frequency and magnitude of storm-related floods. Stakeholders and policymakers are increasingly seeking economic information to help communities adapt to resulting coastal hazards. The proposed project will develop rigorous social science methods that, when integrated with natural science data and scenarios from Coastal Resilience and supplementary sources, will enable users to evaluate economic benefits, costs and tradeoffs of adaptation strategies. Unlike incomplete estimates based solely on infrastructure and engineering costs, the proposed results will incorporate a more comprehensive perspective including ecosystem service values provided by vulnerable coastal ecosystems, yielding new mechanisms to inform adaptation that generates sustainable benefits. The project engages with partners seeking to assist coastal communities with hazard adaptation to ensure that results will have immediate impact. Outcomes will serve as models for communities region-wide facing similar hazards.
Progress	
Summary	

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	SC
Project Title	Integrating Climate Vulnerability and Working Waterfront Preservation
Investigators	
Partner	ACE Basin National Estuarine Research Reserve (US DOC, NOAA, NOS, NERRS); Albemarle-Pamlico National Estuary Program (US EPA, NEP); Beaufort, SC; Carolina's Integrated Sciences and Assessment Center; Centers for Ocean Sciences Education Excellence, Southe
Description	
Progress	RELEVANCE: The Kitchen Table Climate Study Group of McClellanville, SC (KTCSG) is a community group interested in encouraging adaptation to climate change in their small fishing village, but they need assistance with getting relevant information out to residents. The town government is uncertain about how best to deal with future challenges from increasing rainfall variability and sea level rise. McClellanville also faces several other hazard and climate-related stressors; it sustained severe damage during Hurricane Hugo in 1989, and its low elevation and flat topography already complicate planning for and managing stormwater runoff and erosion. The KTCSG needs a better understanding of what local perceptions are of environmental issues so they can craft an outreach message that addresses adaptation in the context of these other local concerns. RESPONSE: In 2011, the S.C. Sea Grant Consortium partnered with the Social and Environmental Institute (SERI) and the Carolinas Integrated Sciences and Assessments (CISA) center at the University of South Carolina to assist decision-makers in the Town of McClellanville to explore the consequences climate variability and change may have on stormwater management. The facilitated discussion used the Vulnerability and Consequences Adaptation Planning Scenario (VCAPS) process, developed by SERI, CISA, and S.C. Sea Grant, to begin the first formal discussion about climate variability and change among town decision-makers in McClellanville. To build on this work, in 2012 the S.C. Sea Grant Consortium and Oregon Sea Grant conducted 12 interviews with McClellanville residents and community leaders about their perceptions of environmental issues and climate change using funding from NOAA's Sectoral Applications Research Program (SARP) via Oregon Sea Grant. RESULTS: Trained facilitators provided town officials with information about potential climate hazards and then guided them through identifying the consequences of heavy rainfall events, more variable precipitation, and sea level rise on storm-water and drainage in the historic fishing village. Participants described potential impacts of flooding and standing water on the local mosquito population, increased pollutant loads impacts on shellfish beds, and elevated water table heights on private property drainage. They determined that the Town could reduce some of the negative consequences by developing more proactive relationships with County stormwater management, as well as starting educational initiatives for private citizens. Interviewees indicated the forest and marshes surrounding McClellanville are very important to the town's

	identity, as are opportunities for fishing. The changes most often observed by McClellanville residents involved pressures from development, but participants also cited changes in creek water quality and beach erosion. Only three respondents indicated that climate is changing and humans are the main cause; others expressed belief that changes are primarily natural or did not know what could be causing changes. Over half cited public apathy as a significant barrier to adapting to climate change. S.C. Sea Grant is working with the KTCSG to develop public displays and outreach materials that identify how climate change could impact marshes and fishing in McClellanville, this work will be completed in June 2013. The displays will be accompanied by a town workshop to acquire additional public feedback on these issues. The Town of McClellanville will apply the results from the VCAPS process and the workshop activities to begin analyzing how the town can better manage its stormwater and educate its citizens under the conditions of climate variability and change.
Summary	A local citizen's group, the Kitchen Table Climate Study Group of McClellanville, SC, concerned about the impact of climate change and variability on its small fishing village, requested assistance in acquiring information about how and what to communicat

Program	SC
Project Title	Sea Grant Climate Adaptation 2011: Beaufort County, SC-Using Participatory Scenario-Building to Encourage Climate-Resilient Zoning in the Coastal Carolinas
Investigators	
Partner	
Description	The generalized objectives of this project and relevant activities include: 1. Develop an initial assessment of the consequences climate change could have on current zoning and new form-based codes in Beaufort County, SC 2. Build new scenarios of how zoning- and code-related adaptation decisions could impact the resilience of Beaufort County to climate change 3. Write a plan for priority actions to update zoning and form-based codes in the future to encourage cliamte resilience 4. Share lessons learned with other communities in South and North Carolina who are interested in begining to consider climate change but as yet unwilling to commit to doing so
Progress	RELEVANCE: Beaufort County is one of South Carolina's eight coastal counties, located along the southern third of the state's coastal region. Some fifty-one percent of Beaufort County's over 162,000 residents currently live in a FEMA-designated flood zone. The county's rapid growth – 34% since 2000 – ensures that an ever-increasing number of people

	become exposed to flood hazards and the effects of climate change. As part of its 2012 Comprehensive Plan, Beaufort County recognized flooding and sea level rise as a threat, and states that "The potential impacts of sea level rise on low-lying areas should be a consideration in future land use planning, site plan review, and the location of future roads and other public facilities." However, enacting plans that include information on future climate and sea level rise has been difficult for the county because climate scenarios for temperature, precipitation, and sea level rise present a wide range of possible climate futures. RESPONSE: Beaufort County's new emphasis on enacting form-based codes offered an opportunity to incorporate such planning by ensuring that zoning ordinances encouraging economic development and preserving local sense of place also enhance resilience to environmental change. One answer to coping with the lack of precision in available climate data was to focus on building Beaufort County's resilience to a variety of climatic conditions, rather than planning for specific actions in anticipation of specific projections. To do this, Beaufort County required additional expertise and partnerships on climate resilience. In response, the Beaufort County Planning Department partnered with the S.C. Sea Grant Consortium and the Social and Environmental Institute to develop a plan for making the county's zoning more resilient to climate change by using two participatory tools. The team successfully competed for a $99,778 grant from the National Sea Grant Office's Coastal Community Climate Adaptation Initiative (CCCAI) to support climate change resilience work in Beaufort County, S.C. RESULT: The team completed initial scoping for the project, including a preliminary assessment of initial concerns and of county plans that are relevant for climate adaptation. This initial work provided the background necessary for the S.C. Sea Grant Climate Extension Specialist to lead the use of two participatory modeling groups with Beaufort County's Planning Department. S.C. Sea Grant's climate extension specialist organized an initial meeting and strategizing session with the Beaufort County Planning Department. A compilation of Beaufort County's plans and ordinances that may be impacted by climate change has been completed and will inform both interviews in March 2013 and a Vulnerability, Consequences, and Adaptation Planning Scenario (VCAPS) exercise in April 2013. The VCAPS process allows community staff and decision-makers to diagram the impacts of potential climate stressors on municipal management issues and the consequences these impacts would have. The Coastal Community Future Adaptive Capacity Scenario (CC-FACS) process will use the VCAPS diagrams to create scenarios that visualize possible consequences of adaptation actions.
Summary	The S.C. Sea Grant Consortium received a $99,778 competitive grant to help Beaufort County, SC develop scenarios that address climate change resilience in its zoning and ordinances.

Program	SC
Project Title	Observational and Modeling Studies to Benefit the Management and Selection of Borrow Sites for Beach Nourishment

	in South Carolina
Investigators	Kehui Xu (Coastal Carolina University (CCU));
Partner	Olsen and Associates, Inc.;
Description	Beaches are common sedimentary environments along the South Carolina coasts. The condition and stability of these beaches form an integral part of South Carolina's economy, primarily by providing support for local tourism and infrastructure protection during storm events. South Carolina has adopted beach nourishment as the predominant strategy for addressing adverse effects of coastal erosion. Since 1985, at least 24 nourishment projects have occurred in South Carolina, with a total of over 27.5 million cubic yards of sand added at a price of nearly $225 million. Coastal sand resources in South Carolina suitable for beach nourishment are very limited. Efficient and low-impact use of those resources is important to the sustainability of future nourishment programs state-wide, as well as the management of sediment resources regionally. Unfortunately, few studies have been done for reliably predicting borrow pit infill rates and sediment composition based on expected borrow area placement and design. We will seek to provide this crucial information to a coastal community (Town of Hilton Head) by employing an intense sediment transport observation and modeling effort and partnering with the private consulting firm that provides technical help to the Town on these issues. The overall objective is to gain a better understanding of how the borrow pits for beach nourishment infill at the Bay Points Shoals east of the Hilton Head Island, SC. Specifically the researchers propose to collect hydrodynamic and sediment transport data within the bottom boundary layer at three sites near the Hilton Head Island coast and use these data to establish, calibrate and validate hydrodynamic and sediment transport models to study borrow area infilling processes following the dredging. A longer-term goal is to be able to use the models state-wide to understand how borrow pits in other locations will infill, based on determining which parameters are the most important at different locations (tides, waves, source of sediment, etc.) and running the models using a minimum amount of data to predict changes in potential borrow sites.
Progress	RELEVANCE: Beaches are common sedimentary environments along the South Carolina coasts. The condition and stability of these beaches form an integral part of South Carolina's economy, primarily by providing support for local tourism and infrastructure protection during storm events. South Carolina has adopted beach nourishment as the predominant strategy for addressing adverse effects of coastal erosion. Since 1985, at least 24 nourishment projects have occurred in South Carolina, with a total of over 27.5 million cubic yards of sand added at a price of nearly $225 million. Coastal sand resources in South Carolina suitable for beach nourishment are very limited. Efficient and low-impact use of those resources is important to the sustainability of future nourishment programs state-wide, as well as the management of sediment resources regionally. RESPONSE: Few studies have been done for reliably predicting borrow pit infill rates and sediment composition based on expected borrow area placement and design. Sea Grant researchers seek to provide this crucial information to a coastal community by employing, through this pilot effort, an

	intense sediment transport observation and modeling effort and partnering with a private consulting firm that provides technical help to the community on these issues. RESULTS: Year 1 results include the collection of in-situ observations of hydrodynamics and suspended sediment transport and related data for model input. Several sediment transport models have been run and are being validated, and meteorological and oceanographic data have been compiled and pre-processed for inclusion in the Regional Ocean Modeling System (ROMS) model, which continues to be developed.
Summary	An understanding of how borrow pits, which are created as the result of dredging for beach nourishment, infill based on hydrodynamic and sediment transport data and subsequent Regional Ocean Modeling System ROMS) development will inform both resource mana

Program	TX
Project Title	Coastal Resilience website development
Investigators	John Jacob (Texas A&M University (TAMU));
Partner	
Description	OBJECTIVES: To develop a Texas Sea Grant web presence for its coastal resiliency work. METHODOLOGY: Texas Sea Grant will employ a student worker to develop the content and web pages for a new coastal resiliency web presence as part of Texas Sea Grant's website. The web pages will highlight the program's current efforts in this area, available resources and it will continue to evolve as Texas Sea Grant grows this part of its program. The initial content will be based on the Resilient Coast series published by Texas Sea Grant. RATIONALE: Building resilience in coastal communities is an economic imperative for the State Texas. Individuals, businesses, communities and ecosystems all need to be resilient to natural hazards such as storms, sea level rise and drought in order to be sustainable and grow the economy. Texas Sea Grant is working on many issues related to coastal resiliency but lacks a presence on its website to promote an awareness of this important focus area or the specific projects. A website focused on coastal resiliency will provide much needed education, outreach and electronic resources to the public and help further assist Texas Sea Grant in establishing its brand as an important leader in coastal resiliency in Texas.
Progress	
Summary	

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	TX
Project Title	Texas Coastal CHARM: Coastal Resiliency Tools for Local Officials
Investigators	John Jacob (Texas A&M University (TAMU));
Partner	
Description	Project Abstract Local officials from the City of Rockport, TX and its partners will collaborate with Texas Sea Grant to develop the Texas Coastal CHARM model to assess how their communities can plan, adapt, and respond to climate change impacts over time. The CHARM (Community Health and Resources Management) model is a GIS-based tool designed as a public workshop exercise using a weTable setup. The model allows participants to map out areas of forecasted growth, which the model uses to calculate a range of impacts. Resiliency metrics calculated by the model provides participants the ability to see and understand the potential impacts of growth in certain areas. The model also allows participants to test variables--hurricane strength, construction costs, building codes, water demand, and others-- which are used to update automatically model results. The model is an instructional tool to support local decision-making. Upon completion, local officials in project communities can use the modeling results to take concrete steps to address specific existing and future vulnerabilities along their coast. Results would be used to update official plans, local priorities, and the use of public resources. Objectives Develop an advisory group consisting of local officials, municipal staff, and local stakeholders from the four participating jurisdictions; Conduct four Coastal Resiliency Index exercises; Develop 6 to 8 community specific metrics to incorporate into the CHARM model for assessing impacts from future growth and coastal risks; Gather and clean up approximately 24 GIS data layers for incorporation into the CHARM model; Create a working, updated version of CHARM for Rockport and partner communities; Conduct a speakers series for 3 to presentations on approaches to resiliency planning in coastal communities; Host 2 CHARM workshops for local officials and the public; Perform CHARM model analyses on three preferred growth scenarios; Prepare a Rockport-Aransas Coastal Resiliency Report for delivery to partner communities. Methodology Texas Coastal CHARM relies on outreach, education, and resiliency planning exercises to enable local officials to take steps to address coastal hazards in their community. The planning exercises are built on two existing tools--the Coastal Resiliency Index and the CHARM model. These will be supported with expertise provided by the PIs and a speaker series on approaches to resiliency

	planning in coastal communities. The PIs, with input from local officials, will improve and update the CHARM model with local GIS data and assign coefficients for development types in the model. The model allows participants to create growth scenarios, review existing conditions, and modify assumptions about environmental and economic values in the model. The CHARM exercise is conducted on a weTable that allows teams and non-experts having no GIS experience to prepare their own growth scenarios. The PIs will conduct a CHARM public workshop where participants will be asked to create growth scenarios that meet certain minimum metrics. The PIs will then work with the local advisory group to define three preferred growth scenarios. Outcomes from the CRI exercise, the CHARM public workshop, and the three preferred growth scenarios will be incorporated into a Rockport-Aransas Coastal Resiliency Report. Rationale The City of Rockport and surrounding Aransas County are located on Texas' central gulf coast. It is a low-lying coastal community where the economy, quality of life, and its environment is inseparable from its coastal location. It is also a community whose future is tied to long-term climate change impacts. Communities that are informed about the frequency and intensity of coastal hazards in the future will be in a better position today to plan and prepare for them. The CHARM model achieves this awareness by having participants use a hands on mapping exercise that requires participants to balance the needs of growth with the potential risks of living in a coastal setting, today and in the future. The model is conducted as a public workshop exercise using a weTable. The weTable allows teams to collaboratively explore and use computer-based data on any table-top surface. It is an ideal tool for community projects where participants use data and maps to talk about and define planning priorities and strategies. Together, these approaches will provide local officials with a firm understanding of resiliency goals and what steps they can take to update local plans, policies, and public resources.
Progress	
Summary	

Program	TX
Project Title	Perception of the rip current hazard on Galveston Island and South Padre Island
Investigators	Chris Houser (Texas A&M University (TAMU));
Partner	

Description	The purpose of this study is to analyze public perceptions of the rip current hazard on Galveston and South Padre Islands and to identify appropriate programs to improve the ability of beach users to identify rip currents. Drowning is a major public health problem (Short and Hogan, 1994) that can have substantial social and economic impact in the State of Texas. Between 1999 and 2004, there were 126 drownings on Galveston Island alone (Galveston County Health District, 2004), with most incidents occurring at a limited number of sites (San Luis Pass, East Beach and Stewart Beach) and rip currents identified as the primary cause. It is hypothesized that the number of drowning and rescues on a given day and over the course of a year, reflects the juxtaposition of heavy surf and rip current development with the personal and group behavior (including population, location, time in water, etc.) of those using the beach (Figure 1). Personal and group behavior and the hazard posed by a rip current depends in part on the ability of beach users to be able to identify a rip current and to associate surf conditions with the potential for rip current development. Understanding what features beach users associated with rip currents is an important step in the development of appropriate programs and educational materials aimed at improving the ability of beach users to identify conditions commonly associated with rip current development. With the notable exception of a preliminary study conducted by the PI (Caldwell et al, in prep.) and a recent study by Sherker et al. (2010), little is known if beach users are able to translate existing rip current warning signs and education material into real-world features and states that they can identify before entering the water. To date, no one has determined if the rip current signs (or any other education materials in this area) have been effective in educating beach users about the rip current hazard and in reducing the number of rip current related incidents (C. Brewster, USLA, pers. Comm., 2011).
Progress	
Summary	

Program	TX
Project Title	Integrating Hazard Mitigation into Local Planning to Support Community Resiliency on the Mississippi Gulf Coast
Investigators	
Partner	Florida Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium;

Description	
Progress	Relevance: If true integration of the two plans is to occur, the elected officials must be aware of the need and the benefit. It will be ultimately up to the local elected officials to adopt and implement any policy recommendations, so educating them is. Response: Elected officials have been informed about the project and the importance by written correspondence, brief meeting presentations and at various conferences and seminars. There have been one-on-one conversations and discussions as well. Results: Because the project is still in progress, it is difficult to report the results. However, all elected officials appear to be receptive to the idea of better/more integration and appreciate getting a better understanding of how the two distinct planning processes take place (comp and hazmit).
Summary	When knowledge and information is transferred to local elected officials, they are able to make better informed decisions regarding planning policy.

Program	TX
Project Title	A Generic Television Program on Flooding with Local Application
Investigators	
Partner	Florida Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium;
Description	
Progress	Relevance: Widespread Houston TV viewing audience on flooding problems, solutions. Simultaneous Spanish language broadcast. DVDs provided to viewing audience in English/Spanish. DVDs used in a variety of educational venues, such as Alabama Floodplain Managers convention in "Train the Trainer" packages for educating city/county officials, etc. Mobile Public Library has 15 copies and reports good usage by library patrons. Fifty Mobile, AL, Realtors received 3- hours CE credit for a presentation of "But it never flooded here before!" using DVD and Mobile scriptwriters. Response: Alabama Floodplain Managers report positive reception to presentations of "Train the Trainer" packages. Realtors were very responsive and have asked for a repeat presentation in 2014. Mobile Public Library put DVDs into circulation 11/1/12 and reports 15 checkouts since then. Results: Thousands of English and Spanish speaking Houston TV viewers became

	aware of Houston's coastal topography and its weather patterns, which produce much flooding. Solutions are provided to encourage public support of local efforts to control flooding and to become aware of effects of development on the watershed. The 16-minute generic portion of the program is available for application by many other communities.
Summary	

Program	TX
Project Title	Measuring the Relative Financial Vulnerability of Municipal Governments to Tropical Natural Disaster Risk
Investigators	
Partner	Florida Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium;
Description	
Progress	Relevance: Local governments, such as municipalities and counties, face tremendous financial challenges recovering from natural disaster events, such as hurricanes. Reduced financial health from previous hurricanes make these local public institutions more financially vulnerable to the next storm. Local governments are under increased vulnerability to future cost share requirements that were waived for most Hurricane Katrina emergency costs. Response: University economists evaluated the capacity of existing local governments' financial health prior to and following Hurricane Katrina. In addition, the economists evaluated the financial costs of emergency operations and debris removal these local governments billed. Results: Coastline counties with the highest emergency costs would see their solvency condition deteriorate fourfold if they were required to fund 25% of the future emergency costs of a Katrina-sized hurricane. Local governments will need to improve their solvency condition to two to four times the previously healthy thresholds for solvency to maintain a risk-adjusted financially healthy condition. It is expected adoption of improved solvency conditions will reduce interest costs from borrowing to finance future disaster emergency costs.
Summary	Financial health of most vulnerable Gulf Coast communities to a future Katrina-sized tropical natural disaster need to be improved their solvency condition two to four fold to cover expected local cost-share requirements.

Program	TX
Project Title	Gulf of Mexico Coastal Training Program Initiative for Resilient Communities
Investigators	
Partner	Florida Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium;
Description	
Progress	Relevance: Coastal storms threaten Gulf of Mexico communities and the economic systems that these communities support. Our partnership recognized the benefits of utilizing the Coastal Resilience Index to help identify community resilience needs and then to provide technical assistance to these communities to help them become better prepared before, during and after coastal storms through awareness, planning, preparation and response. Many communities either lack the specific expertise or staffing support to undertake these efforts without outside assistance. Response: An existing partnership of National Estuarine Research Reserves in the Gulf of Mexico worked together to identify communities in their areas of focus to participate in this effort. Work is already underway in Moss Point, Mississippi, and Franklin County, Florida. Results: While difficult to determine specific results at this time, it is clear that community leaders in each community that has completed the Coastal Resilience Index are more aware of the capabilities and vulnerabilities of their community to respond to and recover from coastal storms. We anticipate having more concrete results to report at the end of the project period.
Summary	The Coastal Resilience Index and assistance provided by this project will assist communities in the Gulf of Mexico to increase their awareness of the threat posed by coastal storms and to improve their preparedness, ability to weather and capability to re

Program	TX
Project Title	Determining Best Practices When Reseeding Neighborhoods with Nonprofit Rebuilding after Coastal Storms

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Investigators	
Partner	Florida Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium;
Description	
Progress	Relevance: When non-profits help people rebuild their homes those people benefit immediately, but do these rebuilt homes encourage neighbors? We wanted to find out if rebuilt homes encouraged neighbors to come home sooner. We also wanted to find out if one rebuilt home is enough or if a cluster of rebuilt homes is required. Response: We worked with Phoenix of New Orleans in Mid-City New Orleans. We have presented the preliminary work at two conferences of academics. We hope to present one more time, analyze the data more robustly, and to submit our work to academic journals. We believe that our academic work can be used by city planners and responders. Results: Survival analysis suggests that when Phoenix of New Orleans (PNOLA) rebuilt houses neighbors returned faster.
Summary	The benefits of rebuilding homes is greater than we might have thought.

Program	TX
Project Title	Coastal Resilience Gulf of Mexico - methods, Data and Web-Based Mapping Applications to Inform Coastal Communities on the Risks of Sea Level Rise
Investigators	
Partner	Florida Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium;
Description	
Progress	Relevance: Decision-makers need the critical information necessary to support choices for managing human and natural communities in the face of the coastal changes that are. Despite a growing awareness of the reality of global climate change and sea-level rise, local decision makers often lack the tools to visualize future scenarios and identify alternatives for effective. As a consequence, they are unable to comprehensively integrate SLR and coastal hazard risk into their decision-making to reduce vulnerability while simultaneously increasing the resilience of human and natural

	communities. Response: Chris Shepard and Jorge Brenner organized a joint workshop with Dr. Sam Brody of Texas A&M Galveston, Director of the Texas Institute for Sustainable Coasts. Shepard and Brenner traveled to Galveston Dec. 5-7 to present at the Planning for Sustainable Communities workshop developed in partnership with Texas A&M. More information can be found here: http://hrrc.arch.tamu.edu/outreach/events/ The workshop offered continuing education credits for participants through both the Association of State Floodplain Managers and the American Planning Association. Results: We provided information on the use of habitats to reduce coastal hazards risk and provided training on the Gulf of Mexico Decision Support tool to nearly 30 participants ranging from municipal planners to academic researchers and natural resource managers. Established a point of contact with multiple Galveston Bay communities including Shoreacres, Baytown, League City, Quintana Island, Galveston and Mont Belvieu. We are currently following up with these communities to identify further local level activities and support.
Summary	At our December 2012 workshop, we brought together nearly 30 Galveston Bay area practitioners and planners to learn about hazard mitigation techniques and tools with a focus on green solutions, such as land acquisition and/or restoration.

Program	TX
Project Title	Development of Sea Level Rise Adaptation Planning Procedures and Tools Using NOAA Sea Level Rise Impacts Viewer
Investigators	
Partner	Florida Sea Grant; Louisiana Sea Grant; Mississippi-Alabama Sea Grant Consortium;
Description	
Progress	Relevance: In this study, we have conducted surveys to better understand how sea-level rise is addressed in the urban planning process and how the current NOAA sea-level rise viewer tool contributes in the process. Local planners have been asked for input through interviews and surveys. The online survey was distributed with the help of Tampa Bay Regional Planning Council to local planning professional network. Survey targets include planners, city managers, council members and planning and engineering professionals in the four counties and 20 municipalities in Tampa Bay Region. The questions help the scientific community, researchers and decision support tool developers better understand what have been done for sea-level rise adaptation in practice and how further decision support tool could be useful to

	support the coastal resilience building towards sea-level rise adaptation. It provides useful suggestions for further usability improvements to the current NOAA sea-level viewer tools, and the suggestions have been provided to the NOAA sea-level rise viewer development group. Response: The survey has 49 respondents and 24 effective ones from different agencies, including 7 municipal planning agencies, four county agencies, state and regional environmental protection agency and department of transportation, private planning and engineering companies, and water supply authority. Some municipal agencies did not provide an effective response because they are small municipals who do not have specialized planning staff and their planning work are done by the county planning agencies, from whom we already got effective responses. Results: The results show that the current NOAA SLR viewer provides a good base for adaptation decision support, however, based on the survey further improvements are necessary to better serve the adaptation planning needs through: • Identifying the multidisciplinary and multiagency nature of adaptation planning • Providing policy toolkit/cases and evaluation for education purpose • Adding more useful functions (infrastructure vulnerability, integrated vulnerability, adaptation evaluation) • Adding more data (i.e. critical infrastructure, transportation and utility) • Using more user-friendly interface • Identifying different adaptation scenarios based on distance to the sea • Integrating adaptation evaluation with local comprehensive planning.
Summary	The time range, strategies, funding situation and implementation status of local adaptation planning have been better understood through the research. These findings provide the current sea-level rise adaptation planning tool developers a better understan

Program	USC
Project Title	
Investigators	JAMES FAWCETT (University of Southern California Sea Grant (USC)); Juliette Finzi-Hart (University of Southern California Sea Grant (USC)); Phyllis Grifman (University of Southern California Sea Grant (USC));
Partner	City of Los Angeles, CA Public Works Agency; City of Los Angeles;
Description	Project Abstract: Coastal communities in California are anticipating a climate change scenario in which temperatures will warm significantly during the 21st century, and thus expect an increase in the frequency, magnitude and duration of heat waves and sea level rise (SLR) extremes (Cayan et al. 2009). As such, coastal Californians have recognized the need to plan for the impacts of climate change, specifically SLR. City of Los Angeles (L.A.) Mayor Antonio Villaraigosa has made climate change adaptation one of his top priorities in this region of fourteen million, home to the nation's busiest

	seaport. Having a champion such as the mayor is an important first step in implementing any adaptation planning efforts, which require not only astute consideration of potential impacts, but the political will to effect change (Young, 2007). In response to a request from the Mayor, USC Sea Grant is proposing to develop a city-led, science-based, and stakeholder-supported process ("AdaptLA") to help the City begin planning for the impacts of climate change, focusing first on SLR. We will work with the City to develop the baseline analyses necessary to effective adaptation plan, including an existing conditions report and a review of existing City policies. To achieve this we have established 4 major milestones: • Milestone 1: Develop and train AdaptLA planning teams • Milestone 2: Conduct existing conditions analysis • Milestone 3: Conduct review of existing policies • Milestone 4: Build support within the broader L.A. community for AdaptLA planning process The development of effective and supported planning teams will be the most important step in this process. Planning teams will consist of an Adaptation Planning Team (APT), a Technical Advisory Committee (TAC, comprised of city officials and select subject matter experts), and a Stakeholder Working Group (SWG, comprised of L.A. City Council staff, County of L.A. representatives, business, industry, government associations, and non-governmental organizations, among others). Both the existing conditions analysis and review of existing policies, though led by USC Sea Grant and project partners, will be primarily developed by input from the TAC and SWG. These reports will also be reviewed by the broader L.A. community in several public fora within the City's coastal communities. We hypothesize that, using our proposed methodology, AdaptLA, will be supported by City officials, stakeholders and the broader LA community, leading to an efficient and effective planning process. This is in comparison to a plan created by a top-down process, which then requires seeking support and buy-in from agencies, stakeholders, and the public in order to achieve successful implementation (SPIDR, 1997). As one of the largest cities in the nation, Los Angeles faces complex challenges preparing for the impacts of a changing climate on infrastructure operations and the safety of its large population. Strategies developed for the City of L.A. will address many of the issues faced by other large cities around the nation and the world as they grapple with their own preparedness. We envision that the process we have outlined for this project will be used not only by the City of L.A., but also by the County of L.A. and the region as climate change adaptation planning continues in some jurisdictions and commences in others. We will have developed a planning model that incorporates scientific expertise, multiple management jurisdictions, stakeholder input and that has the backing of political leaders from the outset. It will be robust and capable of assessing and prioritizing the most pressing issues and developing methodologies for addressing them. Lastly, outreach to the broader L.A. community will be an important component of AdaptLA, for any city-led planning effort will meet perhaps insurmountable resistance without community support. USC Sea Grant, experts in communication of research, will partner with the City of L.A.'s communication and community outreach departments to hold public fora in which the L.A. community will have the opportunity to learn about the AdaptLA goals and process and to provide feedback on the existing conditions report and existing policy review.
Progress	Relevance: Climate change and its effects—sea level rise, increased temperatures, increased intensity of storms, etc— have made it critical for coastal communities to plan current and future adaptation strategies. Climate change

	adaptation planning is especially crucial for the City of Los Angeles. With a population of 4 million, the City of LA owns and maintains coastal infrastructure including two wastewater treatment plants, two power plants and the Port of LA. LA's economy is dependent upon beach tourism and recreation, accounting for more than $15 billion in expenditures and $8 billion in tax revenues annually. In LA, there is a considerable need for capacity building and enhanced collaboration, vulnerability assessments, and guidelines and metrics to measure the effectiveness of various adaptation strategies. USC Sea Grant developed AdaptLA, a science-based and stakeholder-supported sea level rise adaptation planning process and vulnerability study for the City of Los Angeles. This participatory process included multiple planning meetings, engaged city leadership, and included significant regional stakeholder participation. USC commissioned four studies to examine the risk to coastal assets, and the physical, social and economic vulnerabilities of sea level rise and intensifying coastal storms to city infrastructure, resources and communities. The process and studies are summarized in overall report developed by USC and will be released in the Summer 2013. Results: This project has enhanced knowledge and understanding of climate science and vulnerability to sea level rise to assets and communities, building capacity in the City of Los Angeles and surrounding cities and communities. The project has significantly enhanced collaboration and coordination in the region, and has led to a sea level rise regional planning process that formed in May 2013 to examine impacts and vulnerabilities across LA region. The methodology developed in the AdaptLA project is being used as a model to develop a LA regional planning process.
Summary	USC Sea Grant led the development of sea level rise adaptation planning process for the City of Los Angeles to help the City identify vulnerable assets, resources and communities, recommends actions that can be taken in the near term, and provides guidanc

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Project Title	
Investigators	JAMES FAWCETT (University of Southern California Sea Grant (USC)); Juliette Finzi-Hart (University of Southern California Sea Grant (USC)); Phyllis Grifman (University of Southern California Sea Grant (USC));
Partner	City of Los Angeles, CA Public Works Agency; City of Los Angeles;
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Progress	Relevance: Decision-makers in California's coastal counties recognize that climate change will impact their communities and coastline and understand they need to begin planning for these impacts. Many different organizations in CA have started providing training and scientific information to these communities to help them begin planning – often times overwhelming communities. Response: During the summer of 2011, with the goal of coordinating statewide efforts, USC Sea Grant, in partnership with 14 other CA-based organizations, conducted a survey to understand the needs and barriers coastal communities have in planning for climate change. One major goal of the survey was to develop appropriate and targeted trainings and technical assistance for communities and to determine the best way to link communities to resources and tools already available. Results: Approximately 600 coastal professionals, representing all CA coastal counties, responded to the survey. Results demonstrated that CA coastal professionals overwhelmingly believe climate change is real and exacerbated by human activities. Despite limited staff and financial resources, many communities either have or are ready to begin planning. The survey allowed the 15 partner organizations to identify important next steps to help these coastal communities plan for climate change. As a direct result of the survey, the CA Ocean Protection Council has launched a $2.5 million program to help coastal communities include climate change in updating local coastal plans. Moreover, the survey partners formed the California Climate Adaptation Trainers Coalition (C-CATC), with the goal of further coordinating community assistance efforts.
Summary	A statewide survey led by USC Sea Grant, in partnership with CA Sea Grant and 13 other organizations, demonstrated that CA coastal professionals are ready to begin planning for climate change. Results of the survey prompted the allocation of $2.5 million

Program	USC
Project Title	Climate Adaptation Planning for Los Angeles
Investigators	Juliette Finzi-Hart (University of Southern California Sea Grant (USC));
Partner	City of Los Angeles, CA Bureau of Sanitation; City of Los Angeles, CA Environmental Monitoring Division; City of Los Angeles, CA Public Works Agency; City of Los Angeles; County of Los Angeles, CA Department of Public Works; Los Angeles, CA City Council;
Description	OBJECTIVES: USC Sea Grant currently has a number of ongoing climate change adaptation projects underway (see below). The main objectives for all projects include: • Providing the best scientific information available to local and regional climate adaptation planning • Developing communication and outreach products that help local communities

plan for climate change • Developing and leveraging partnerships with local communities and regionally to advance climate adaptation planning. METHODOLOGY: California Coastal Climate Adaptation Needs Assessment Survey With funding from the FY10 CCCAI, USC Sea Grant, in partnership with California Sea Grant and 15 other California-based coastal organizations, led the development of a statewide survey of California coastal professionals to understand: current coastal management challenges; concerns, knowledge, and actions to prepare for climate change impacts; and, information, technical assistance, and training needs to support adaptation planning and implementation. The survey was conducted in 2011 and analysis of survey results in underway. An initial report is under review and will be released at the end of May 2012. We request funds to: continue analyzing the survey results; disseminate the findings; begin to develop programs to address identified stakeholder needs; and, salary support for Phyllis Grifman (Associate Director) Juliette Hart (Regional Research and Planning Specialist) and Marika Schulhof (USC Sea Grant intern). City of Los Angeles Sea Level Rise Adaptation Planning (AdaptLA) The City of L.A. owns and maintains critical coastal infra¬structure, including two power plants, two water treat¬ment plants, and the Port of Los Angeles. All are vulnerable to impacts from coastal change and accelerating sea level rise (SLR). In partnership with the city, we have developed a city-led, science-based, and stakeholder-supported process to help the city begin planning for the impacts of climate change. The first effort will focus on the impacts of coastal change and SLR on the city's coastal infrastructure and properties. Major milestones include: developing an existing conditions report; conducting a physical and social vulnerability assessment; identifying appropriate SLR adaptation measures; and, developing an SLR adaptation plan. We were granted one of the larger $100,000 CCAI grants earlier this year, which is supporting a large portion of this work, including the development of the process and collaboration with ICLEI – Local Governments for Sustainability to conduct the physical vulnerability assessment.   We request further funds to work with a consultant to conduct an economic analysis of the impacts of climate change for the City, develop communication/outreach products of AdaptLA planning effort; local travel to City meetings; and, salary support for Phyllis Grifman (Associate Director) Juliette Hart (Regional Research and Planning Specialist) and Marika Schulhof (USC Sea Grant intern). Los Angeles Regional Collaborative for Climate Action and Sustainability USC Sea Grant is on the steering committee of the Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC). LARC is a network designed to encourage greater coordination and cooperation at the local and regional levels by bringing together leadership from government, the business community, academia, labor, environmental and community groups. The purpose of this collaboration is to share information, foster partnerships, and develop system-wide strategies to address climate change and promote a green economy through sustainable communities. USC Sea Grant has taken a leadership role with LARC and is leading LARC's climate adaptation efforts, primarily through the AdaptLA effort. LARC has also begun coordinating with the two other major regional climate change planning efforts across the state (in San Diego and San Francisco Bay area, currently tentatively called the "Collaboration of Collaboratives of California – or CoCoCal). This group will be holding meetings over the course of the next year, in partnership with the California Governor's Office of Planning and Research, to leverage resources, share lessons learned and work with the state of California to identify appropriate next steps for climate planning across

	the state. We request funds to attend to a statewide meeting of the CoCoCal. RATIONALE: Through the various efforts we have described above, USC Sea Grant is quickly becoming recognized as the leader for climate adaptation planning (specifically for sea level rise) in the greater Los Angeles region. Through our work with the City of Los Angeles and through our leadership role in the LARC, the model for climate adaptation planning that we have developed for the City of L.A. is being emulated by the other 88 cities within Los Angeles County. With a population of over 10 million, the outcomes of our work have far reaching impacts.
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Project Title	Climate Adaptation Planning for Los Angeles

Investigators	Juliette Finzi-Hart (University of Southern California Sea Grant (USC));
Partner	City of Los Angeles, CA Bureau of Sanitation; City of Los Angeles, CA Environmental Monitoring Division; City of Los Angeles, CA Public Works Agency; City of Los Angeles; County of Los Angeles, CA Department of Public Works; Los Angeles, CA City Council;
Description	OBJECTIVES: USC Sea Grant currently has a number of ongoing climate change adaptation projects underway (see below). The main objectives for all projects include: • Providing the best scientific information available to local and regional climate adaptation planning • Developing communication and outreach products that help local communities plan for climate change • Developing and leveraging partnerships with local communities and regionally to advance climate adaptation planning. METHODOLOGY: California Coastal Climate Adaptation Needs Assessment Survey With funding from the FY10 CCCAI, USC Sea Grant, in partnership with California Sea Grant and 15 other California-based coastal organizations, led the development of a statewide survey of California coastal professionals to understand: current coastal management challenges; concerns, knowledge, and actions to prepare for climate change impacts; and, information, technical assistance, and training needs to support adaptation planning and implementation. The survey was conducted in 2011 and analysis of survey results in underway. An initial report is under review and will be released at the end of May 2012. We request funds to: continue analyzing the survey results; disseminate the findings; begin to develop programs to address identified stakeholder needs; and, salary support for Phyllis Grifman (Associate Director) Juliette Hart (Regional Research and Planning Specialist) and Marika Schulhof (USC Sea Grant intern). City of Los Angeles Sea Level Rise Adaptation Planning (AdaptLA) The City of L.A. owns and maintains critical coastal infra¬structure, including two power plants, two water treat¬ment plants, and the Port of Los Angeles. All are vulnerable to impacts from coastal change and accelerating sea level rise (SLR). In partnership with the city, we have developed a city-led, science-based, and stakeholder-supported process to help the city begin planning for the impacts of climate change. The first effort will focus on the impacts of coastal change and SLR on the city's coastal infrastructure and properties. Major milestones include: developing an existing conditions report; conducting a physical and social vulnerability assessment; identifying appropriate SLR adaptation measures; and, developing an SLR adaptation plan. We were granted one of the larger $100,000 CCAI grants earlier this year, which is supporting a large portion of this work, including the development of the process and collaboration with ICLEI – Local Governments for Sustainability to conduct the physical vulnerability assessment. We request further funds to work with a consultant to conduct an economic analysis of the impacts of climate change for the City, develop communication/outreach products of AdaptLA planning effort; local travel to City meetings; and, salary support for Phyllis Grifman (Associate Director) Juliette Hart (Regional Research and Planning Specialist) and Marika Schulhof (USC Sea Grant intern). Los Angeles Regional Collaborative for Climate Action and Sustainability USC Sea Grant is on the steering committee of the Los Angeles Regional Collaborative for Climate Action and Sustainability (LARC). LARC is a network designed to encourage greater coordination and

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Progress	Relevance: Climate change and its effects—sea level rise, increased temperatures, increased intensity of storms, etc—have made it critical for coastal communities in California to plan current and future adaptation strategies. Enhancing knowledge and understanding of climate science, vulnerability and risk assessment, and strategies for adaptation is crucial for agencies and organizations planning for a changing climate. Response: As a result of the California needs assessment survey as well as expressed need by local jurisdictions engaging in adaptation planning efforts (e.g. AdaptLA), USC Sea Grant partnered with the NOAA Coastal Services Center and others to deliver an intensive and highly interactive three-day training course providing participants with a climate adaptation toolkit to proactively address adaptation planning priorities in the context of local government priorities. We brought in local adaptation and climate science experts from the Los Angeles region to discuss adaptation planning concepts to address coastal climate change issues, and how to integrate strategies into policy, plans and programs. Results: This project trained 21 individuals in climate change processes and adaptation strategies. This group consisted of land use planners, coastal managers, public works staff, port managers, local officials, municipal boards, community groups, and environmental organizations, building capacity and understanding in the Los Angeles region. As a result, many of those trained served as stakeholder participants in the AdaptLA process and are now actively engaged in regional sea level rise planning in the greater Los Angeles region.
Summary	To enhance knowledge and understanding of climate change processes and strategies for adaptation in the Los Angeles region, USC and partners developed and delivered a Climate Change Adaptation Training, customized for Los Angeles planners, policy-makers a

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Progress	Relevance: Coastal managers in California are faced with the challenge of protecting coastal environments and resources from the impacts of climate change. Shoreline change, resulting from the confluence of sea level rise, coastal erosion, storm surge, El Niño, flooding, and inundation, threatens coastal communities, infrastructure, and natural habitats. As more models and tools have become available to aid in the development of vulnerability assessments and adaptation strategies, coastal managers expressed their need to better understand the purpose and capabilities of these different models and tools. Equally, a need was expressed among scientists to better understand practitioner needs as they develop models and tools to support those needs. Response: USC Sea Grant and partners developed a workshop convening speakers to share information about the latest science behind sea level rise projections, and help bridge the

	gap between coastal managers and modelers. The workshop provided a forum for pairs of scientist and manager teams to present on California-based case studies to illustrate available model approaches and applications. The workshop also provided an opportunity to describe state and federal guidance on sea level rise, provide demonstrations on tools, and provide a breakout session for scientists and practitioners to discuss barriers in moving models to the next level. 78 attendees representing 47 organizations and agencies participated in the event. Results: This workshop not only served as a venue for building capacity and knowledge of climate science and models among California's planners and policy-makers, but also served as an opportunity for bi-directional information transfer to occur among scientists and practitioners. Scientists heard from managers about management needs and tool utility (i.e. the "holy grail" of desired modeling) to inform future research and modeling efforts. Likewise, managers heard from scientists about the state-of-the science and application constraints.
Summary	USC Sea Grant and partners delivered a cutting-edge workshop to bring together sea level rise and shoreline change modelers and the practitioners working on developing adaptation strategies. This workshop built capacity in California and served as a venue

Program	USC
Project Title	2013 National Sea Grant Climate Network Climate Adaptation Conference
Investigators	Juliette Hart (University of Southern California Sea Grant (USC));
Partner	
Description	OBJECTIVES: Given the success of the CCCAI program and the ensuing increase in climate change activities across all Sea Grant programs, the NSGCN is working to organize its next national conference. Throughout 2011, the steering committee conducted both internal and network-wide polls (through the NSGCN "ning" website and through an online survey) to determine the level of support for another conference and what topics would be most relevant for network participants. There was overwhelming interest in holding a conference. Topics of interest included: • Panels on most common research projects across the Sea Grant Programs (e.g. sea level rise planning; impacts of storminess on coastal ecosystems and infrastructure; and, water security) that addressed methodologies, resources developed/utilized, and lessons learned • More information on the ecological impacts of climate change and potential adaptation measures (e.g., the impacts of ocean acidification on coastal shellfish fisheries; or, the impact of rising seas on the conservation

and management of coastal wetlands) • Knowledge-sharing on effective tools, lessons learned, and best way to document both individual and network-wide impacts and economic value • Professional development (e.g. climate change communication training or another similar training opportunity) The overarching goals of a NSGCN National Conference, then, are to: • Learn about other climate change activities across the Sea Grant programs and share lessons learned • Network and build relationships to increase capacity within individual, and across, Sea Grant programs and to leverage resources in these austere economic times in order to do more climate change work • Gain professional development through a targeted training that meets the needs of the meeting attendees METHODOLOGY: We are proposing a three-day conference. All NSGCN members will be invited to attend a public meeting on the first day (see detail below about the USC Dornsife 2020 project and accompanying match). This public meeting will be planned so that efforts within California, that are relevant at the national scale, are presented to set the stage for day two and three of the NSGCN conference. During the second and third day of the NSGCN conference, attendees will engage in discussions of relevant climate change projects (both CCCAI-funded and other) and will receive professional training. We are proposing that the conference be held in Los Angeles, California. Los Angeles is a major national and international destination and is economical and convenient to reach from most locations in the U.S. (usually requiring no more than one layover). Additionally, it is a much shorter and less expensive journey for Sea Grant programs located in the Hawaiian or Pacific Islands and Alaska. To ensure geographic equity in events, holding this conference on the West Coast of the U.S. is appropriate. We anticipate that extension personnel on the West Coast who did not have the opportunity to attend either of the previous meetings will be able to attend the meeting in a geographically more accessible location. Moreover, in the last several years, climate change planning activities in California, and particularly Los Angeles, have gained momentum. In 2006, the State of California passed the landmark Global Warming Solutions Act (Assembly Bill 32) that mandates mitigating the impacts of climate change by reducing greenhouse gas emissions. In 2009, the State of California Natural Resources Agency developed a California Adaptation Strategy, which is currently being revised.   Within Los Angeles, USC Sea Grant leads the City of Los Angeles's sea level rise adaptation planning efforts (AdaptLA) and plays a leading role in a broader regional climate planning initiative through the Los Angeles Regional Collaborative on Climate Action and Sustainability. Cutting-edge climate science that drives California climate policies and actions is conducted at the NOAA-funded California Nevada Applications Program (CNAP) at the Scripps Institution of Oceanography, University of California, San Diego through the NOAA Regional Integrated Sciences and Assessment (RISA) Program. Both the USC and CA Sea Grant Programs have partnered with CNAP on both scientific and policy-focused studies. Moreover, USC Sea Grant and CA Sea Grant, in partnership with 14 other organizations, coordinated a statewide climate adaptation survey of coastal county and city professionals to understand their current coastal management challenges, where they are in adaptation planning, and their information/technical needs. The results from this survey will be released at the end of May 2012. There are therefore a number of studies and activities underway in California that could be used as case studies for further discussion. Discussions in the SGCN indicate there is a high level of interest in pursuing this track. USC Sea Grant has been on the steering committee for the USC Dornsife

2020 ("2020") Initiative, which is intended to help the University and the greater Southern California region prepare for the emerging challenges to be addressed over the coming decade and beyond. As part of this internally supported initiative, PIs Doug Capone and Dave Hutchins were awarded funds to support a three year project entitled "Climate Change in the Southern California Bight: Science and Societal Implications." The award is being used to support a full-time postdoctoral position, as well as an annual series of professional and public outreach workshops. Two workshops have already been held as part of this initiative. In fall 2010, USC held a data workshop in which speakers briefly described their own climate change-relevant data sets for the Southern California Bight, including subjects such as parameters measured, spatial and temporal coverage, and availability of the data for access by the scientific community and for cross-linking with other regional data sets. This was followed by a science-policy workshop in Fall 2011, which focused on the impacts of sea-level rise to the Southern California coastline, the impacts of ocean acidification, California's current climate policies and effective climate change communication. Another workshop scheduled for Oct. 2012 will focus on discussions of modeling programs.   USC Sea Grant is currently planning the last public policy forum, which will be held in March 2012. We are proposing to plan the NSGCN Conference to occur in the days following the 2020 forum in order to leverage resources. For instance, one of the speakers tentatively scheduled to present at the 2020 forum, Dr. Susanne Moser, one of the speakers tentatively scheduled to present at the 2020 forum, will be speaking on social vulnerability associated with climate change. Dr. Moser has expressed verbal interest in remaining in Los Angeles to provide climate change communication training at the NSGCN conference. Other speakers for the 2020 forum have yet to be identified, but the PIs of the 2020 project have indicated they would welcome identifying speakers who would speak to both California- and national-scale interests. As such, the 2020 project is providing match through one month's salary support for Dr. Juliette Finzi Hart, travel for Dr. Moser and lunch for NSGCN conference attendees. RATIONALE: The NSGCN Climate Adaptation Conference matches most closely with the Sea Grant Program Focus Area, Hazard Resilience as stated in the Special Funding Opportunity Announcement: In the area of hazard resilient coastal communities: widespread understanding of the risks associated with living, working, and doing business along the nation's coasts; community capacity to prepare for and respond to hazardous events; and effective response to coastal catastrophes. However, climate change extension by its nature is cross-cutting and multi-disciplinary. Thus, themes addressing the other Sea Grant focus areas (safe and sustainable seafood supply, sustainable coastal development, healthy coastal ecosystems, and hazard resilient coastal communities) will also be addressed throughout the conference. With respect to the NOAA Strategic Plan, the NSGCN Conference meets these criteria: ● Understand Climate Variability and Change to Enhance Society's Ability to Plan and Respond; ● Serve Society's Needs for Weather and Water Information; Outreach and Education As noted, the mission of the NSGCN is to "shar[e] talent and resources" and to "increase the effectiveness of Sea Grant climate programming and outreach nationwide." The goals of this conference are to provide a forum for enhancing meeting the NSGCN's mission.   After the conference, results of the conference will be reported to the National Sea Grant Office. In addition, the NSGCN will post meeting materials and outcomes on the network's "ning" social networking site (sgccnetwork.ning.com). In addition, the steering committee

	will work with the regional network members to ensure that any outcomes or information generated at the NSGCN conference be disseminated widely throughout the network. The NSGCN has already developed a database of ongoing CCCAI and climate change-related projects across the network. This database will be updated after this conference and will again be made available on the "ning" site. We will conduct post-conference evaluations (via online survey, followed up with a selected set of personal interviews) to determine if the conference goals were met. Further, USC Sea Grant's education program is charged with developing materials and offering educator workshops in both formal and informal settings on extension initiatives. Our education program on climate change is already well underway and the training and network collaboration resulting from this conference will be further developed as an educational initiative with the Sea Grant Educator Network.
Progress	Relevance: Recognizing an upward trend in global temperature that could have significant impacts on our nation, climate change has been brought to the forefront of Sea Grant's national agenda over the last few decades. As a result, a national network of Sea Grant outreach professionals working on climate issues within their states and communities was established. The NOAA National Sea Grant Office made funding available to provide an opportunity for Sea Grant colleagues from all programs to share progress on their climate adaptation planning projects. Response: USC Sea Grant applied for the funding, offering to host and plan the 2013 Sea Grant Climate Network workshop in Los Angeles in March 2013. Funding was granted, and USC provided matching funds to convene the workshop and coordinate it with the USC-funded "2020" Climate Change Initiative. Results: Along with a steering committee, USC Sea Grant assembled an agenda aimed at providing an opportunity for Sea Grant professionals to learn about other climate change activities across the Sea Grant programs and share lessons learned, network and build relationships across and within individual Sea Grant programs to increase capacity and leverage resources, and gain professional development through a targeted training that meets the needs of the meeting attendees. The agenda included a keynote presentation on ocean acidification, a climate communications training, a seminar on human dimensions and ocean health issues, a tools demonstration and a panel session on Sea Grant climate adaptation work with local communities.
Summary	By the end of the reporting period, USC had achieved significant progress toward a successful workshop for Sea Grant extension professionals actively working on climate change issues in their region.

Program	USC
Project Title	2013 National Sea Grant Climate Network Climate Adaptation Conference
Investigators	Juliette Hart (University of Southern California Sea Grant (USC));

Partner	
Description	OBJECTIVES: Given the success of the CCCAI program and the ensuing increase in climate change activities across all Sea Grant programs, the NSGCN is working to organize its next national conference. Throughout 2011, the steering committee conducted both internal and network-wide polls (through the NSGCN "ning" website and through an online survey) to determine the level of support for another conference and what topics would be most relevant for network participants. There was overwhelming interest in holding a conference. Topics of interest included: • Panels on most common research projects across the Sea Grant Programs (e.g. sea level rise planning; impacts of storminess on coastal ecosystems and infrastructure; and, water security) that addressed methodologies, resources developed/utilized, and lessons learned • More information on the ecological impacts of climate change and potential adaptation measures (e.g., the impacts of ocean acidification on coastal shellfish fisheries; or, the impact of rising seas on the conservation and management of coastal wetlands) • Knowledge-sharing on effective tools, lessons learned, and best way to document both individual and network-wide impacts and economic value • Professional development (e.g. climate change communication training or another similar training opportunity) The overarching goals of a NSGCN National Conference, then, are to: • Learn about other climate change activities across the Sea Grant programs and share lessons learned • Network and build relationships to increase capacity within individual, and across, Sea Grant programs and to leverage resources in these austere economic times in order to do more climate change work • Gain professional development through a targeted training that meets the needs of the meeting attendees METHODOLOGY: We are proposing a three-day conference. All NSGCN members will be invited to attend a public meeting on the first day (see detail below about the USC Dornsife 2020 project and accompanying match). This public meeting will be planned so that efforts within California, that are relevant at the national scale, are presented to set the stage for day two and three of the NSGCN conference. During the second and third day of the NSGCN conference, attendees will engage in discussions of relevant climate change projects (both CCCAI-funded and other) and will receive professional training. We are proposing that the conference be held in Los Angeles, California. Los Angeles is a major national and international destination and is economical and convenient to reach from most locations in the U.S. (usually requiring no more than one layover). Additionally, it is a much shorter and less expensive journey for Sea Grant programs located in the Hawaiian or Pacific Islands and Alaska. To ensure geographic equity in events, holding this conference on the West Coast of the U.S. is appropriate. We anticipate that extension personnel on the West Coast who did not have the opportunity to attend either of the previous meetings will be able to attend the meeting in a geographically more accessible location. Moreover, in the last several years, climate change planning activities in California, and particularly Los Angeles, have gained momentum. In 2006, the State of California passed the landmark Global Warming Solutions Act (Assembly Bill 32) that mandates mitigating the impacts of climate change by reducing greenhouse gas emissions. In 2009, the State of California Natural Resources Agency developed a California Adaptation Strategy, which is currently

being revised.   Within Los Angeles, USC Sea Grant leads the City of Los Angeles's sea level rise adaptation planning efforts (AdaptLA) and plays a leading role in a broader regional climate planning initiative through the Los Angeles Regional Collaborative on Climate Action and Sustainability. Cutting-edge climate science that drives California climate policies and actions is conducted at the NOAA-funded California Nevada Applications Program (CNAP) at the Scripps Institution of Oceanography, University of California, San Diego through the NOAA Regional Integrated Sciences and Assessment (RISA) Program. Both the USC and CA Sea Grant Programs have partnered with CNAP on both scientific and policy-focused studies. Moreover, USC Sea Grant and CA Sea Grant, in partnership with 14 other organizations, coordinated a statewide climate adaptation survey of coastal county and city professionals to understand their current coastal management challenges, where they are in adaptation planning, and their information/technical needs. The results from this survey will be released at the end of May 2012. There are therefore a number of studies and activities underway in California that could be used as case studies for further discussion. Discussions in the SGCN indicate there is a high level of interest in pursuing this track. USC Sea Grant has been on the steering committee for the USC Dornsife 2020 ("2020") Initiative, which is intended to help the University and the greater Southern California region prepare for the emerging challenges to be addressed over the coming decade and beyond. As part of this internally supported initiative, PIs Doug Capone and Dave Hutchins were awarded funds to support a three year project entitled "Climate Change in the Southern California Bight: Science and Societal Implications." The award is being used to support a full-time postdoctoral position, as well as an annual series of professional and public outreach workshops. Two workshops have already been held as part of this initiative. In fall 2010, USC held a data workshop in which speakers briefly described their own climate change-relevant data sets for the Southern California Bight, including subjects such as parameters measured, spatial and temporal coverage, and availability of the data for access by the scientific community and for cross-linking with other regional data sets. This was followed by a science-policy workshop in Fall 2011, which focused on the impacts of sea-level rise to the Southern California coastline, the impacts of ocean acidification, California's current climate policies and effective climate change communication. Another workshop scheduled for Oct. 2012 will focus on discussions of modeling programs.   USC Sea Grant is currently planning the last public policy forum, which will be held in March 2012. We are proposing to plan the NSGCN Conference to occur in the days following the 2020 forum in order to leverage resources. For instance, one of the speakers tentatively scheduled to present at the 2020 forum, Dr. Susanne Moser, one of the speakers tentatively scheduled to present at the 2020 forum, will be speaking on social vulnerability associated with climate change. Dr. Moser has expressed verbal interest in remaining in Los Angeles to provide climate change communication training at the NSGCN conference. Other speakers for the 2020 forum have yet to be identified, but the PIs of the 2020 project have indicated they would welcome identifying speakers who would speak to both California- and national-scale interests. As such, the 2020 project is providing match through one month's salary support for Dr. Juliette Finzi Hart, travel for Dr. Moser and lunch for NSGCN conference attendees. RATIONALE: The NSGCN Climate Adaptation Conference matches most closely with the Sea Grant Program Focus Area, Hazard Resilience as stated in the Special Funding Opportunity Announcement: In the area of hazard resilient coastal

	communities: widespread understanding of the risks associated with living, working, and doing business along the nation's coasts; community capacity to prepare for and respond to hazardous events; and effective response to coastal catastrophes. However, climate change extension by its nature is cross-cutting and multi-disciplinary. Thus, themes addressing the other Sea Grant focus areas (safe and sustainable seafood supply, sustainable coastal development, healthy coastal ecosystems, and hazard resilient coastal communities) will also be addressed throughout the conference. With respect to the NOAA Strategic Plan, the NSGCN Conference meets these criteria: ● Understand Climate Variability and Change to Enhance Society's Ability to Plan and Respond; ● Serve Society's Needs for Weather and Water Information; Outreach and Education As noted, the mission of the NSGCN is to "shar[e] talent and resources" and to "increase the effectiveness of Sea Grant climate programming and outreach nationwide." The goals of this conference are to provide a forum for enhancing meeting the NSGCN's mission. After the conference, results of the conference will be reported to the National Sea Grant Office. In addition, the NSGCN will post meeting materials and outcomes on the network's "ning" social networking site (sgccnetwork.ning.com). In addition, the steering committee will work with the regional network members to ensure that any outcomes or information generated at the NSGCN conference be disseminated widely throughout the network. The NSGCN has already developed a database of ongoing CCCAI and climate change-related projects across the network. This database will be updated after this conference and will again be made available on the "ning" site. We will conduct post-conference evaluations (via online survey, followed up with a selected set of personal interviews) to determine if the conference goals were met. Further, USC Sea Grant's education program is charged with developing materials and offering educator workshops in both formal and informal settings on extension initiatives. Our education program on climate change is already well underway and the training and network collaboration resulting from this conference will be further developed as an educational initiative with the Sea Grant Educator Network.
Progress	Relevance: Climate change impacts will affect the ocean and coastal ecosystem, as well as coastal communities. The implications of these changes are even more complex in a marine setting that borders a densely populated major urban area, such as the greater Los Angeles basin. Response: The Climate Change in the Southern California Bight project was developed to better understand the science and policy of oceanic climate change in the Southern California region. The first goal of this project is to increase communication and promote collaboration between the diverse group of researchers that deal with all aspects of ocean climate change issues in this region. The second goal is to educate the USC family and interested citizens about the impacts of climate change in our region. Results: Two science-focused workshops and two policy-focused colloquia were held throughout this project. The first workshop allowed scientists from the region to share information about oceanographic research and data. The second science workshop focused on modeling both the impacts of climate change to the Southern California bight as well as the influence of major urban metropolises on coastal waters. The policy workshops focused on climate change communication, policy and adaptation and were open to scientists as well as to the broader public. The second policy workshop, planned for March 2013, will be part of the National Sea Grant Climate Network conference and will highlight sea level rise planning efforts in the

	region.
Summary	The project, Climate Change in the Southern California Bight, allowed scientists from the region to share information about oceanographic research and modeling, building stronger collaborations among ~ 50 local scientists. Concurrent policy workshops help

Program	VA
Project Title	Hampton Roads Adaptation Forum: Knowledge Management Network to Spur Innovation and Adoption of Adaptation Best Practices [VASG]
Investigators	Troy Hartley (Virginia Sea Grant);
Partner	Chesapeake Bay Office (US DOC, NOAA, NMFS); City of Chesapeake; City of Franklin; City of Newport News; City of Norfolk, VA; City of Suffolk; Coastal Services Center (US DOC, NOAA, NOS, CSC); Gloucester County; Hampton Roads Planning District Commission;
Description	OBJECTIVES: To address this Hampton Roads climate adaptation challenge, we propose to assemble a local community-university team to build local adaptation capacity by: - Supplying the knowledge management system and facilitative services for the Hampton Roads Adaptation Forum that enhances information sharing and effective, efficient community adaptation responses and improves the capacity of coastal communities - Identifying and addressing the greatest risks and vulnerabilities in specific sub-systems within Hampton Roads, with feasible, widely adoptable solutions. - Producing demonstrable outcomes through enhanced knowledge management and on- the-ground adaptation activities by local authorities that directly contribute to community adaptation activities. - Fostering and building a comprehensive adaptation response in Hampton Roads that facilitates and promotes local-state-Federal synchronization. METHODOLOGY: The Hampton Roads Adaptation Forum will be launched by VASG and its' institutional partner, ODU, and its' community partner, HRPDC, and in conjunction with our collaborating local, state and federal government partners. Steps to be taken include: 1) Appointing a Forum coordinator and coordinating mechanism, including hosting a knowledge management scoping workshop to identify available information technology options. 2) Administer a Forum, including inviting members from Hampton Roads municipalities, state and Federal agencies, identify additional potential members, design and hold quarterly Forum meetings, and establish topical sub-workgroups and meeting schedule. 3) Design and implement a comprehensive knowledge management system consisting of IT and facilitative communication and coordination strategies; establish knowledge management network performance benchmarks and monitor function against performance; adapt knowledge management system. 4) Design and host two

	facilitated public town hall meetings, aligned with existing local government decision-making procedures, as appropriate. 5) Track implementation of specific adaptation solutions adopted on local community-scales. RATIONALE: Virginia coastal communities face multiple challenges in their efforts to adapt to sea level rise, increased beach and wetland erosion, and flooding from heavy rain events and storm surges. These communities need to protect the value of their economic and community development infrastructure (e.g., tourism, port and maritime trades, military facilities, etc.), including transportation structures and amenities such as beaches. They also need to find ways of managing flood risks to protect residential areas and emergency response facilities. In some cases, where flooding is especially severe or frequent, there may be a need to relocate residences or public facilities. Private sector insurance companies are changing their policies to recognize the increased risk exposure of many land parcels, leaving large numbers of residential customers in these communities uninsured or dependent upon public insurance programs. Further, responsibilities and authority for responding to these challenges fall upon a wide array of public, private, and non-profit organizations at the local, state and federal level. Thus it is extremely difficult to make effective, generalized plans for change when each case of protection and adaptation involves such unique and specific site conditions and agency jurisdictions.
Progress	
Summary	

Program	VA
Project Title	Hampton Roads Adaptation Forum: Knowledge Management Network to Spur Innovation and Adoption of Adaptation Best Practices [ODU]
Investigators	Ariel Pinto (Old Dominion University (ODU)); Benjamin McFarlane (Hampton Roads Planning District Commission); Larry Atkinson (Old Dominion University (ODU));
Partner	
Description	OBJECTIVES: To address this Hampton Roads climate adaptation challenge, we propose to assemble a local community-university team to build local adaptation capacity by: - Supplying the knowledge management system and facilitative services for the Hampton Roads Adaptation Forum that enhances information sharing and effective, efficient community adaptation responses and improves the capacity of coastal communities - Identifying and addressing the

greatest risks and vulnerabilities in specific sub-systems within Hampton Roads, with feasible, widely adoptable solutions. - Producing demonstrable outcomes through enhanced knowledge management and on- the-ground adaptation activities by local authorities that directly contribute to community adaptation activities. - Fostering and building a comprehensive adaptation response in Hampton Roads that facilitates and promotes local-state-Federal synchronization. METHODOLOGY: The Hampton Roads Adaptation Forum will be launched by VASG and its' institutional partner, ODU, and its' community partner, HRPDC, and in conjunction with our collaborating local, state and federal government partners. Steps to be taken include: 1) Appointing a Forum coordinator and coordinating mechanism, including hosting a knowledge management scoping workshop to identify available information technology options. 2) Administer a Forum, including inviting members from Hampton Roads municipalities, state and Federal agencies, identify additional potential members, design and hold quarterly Forum meetings, and establish topical sub-workgroups and meeting schedule. 3) Design and implement a comprehensive knowledge management system consisting of IT and facilitative communication and coordination strategies; establish knowledge management network performance benchmarks and monitor function against performance; adapt knowledge management system. 4) Design and host two facilitated public town hall meetings, aligned with existing local government decision-making procedures, as appropriate. 5) Track implementation of specific adaptation solutions adopted on local community-scales. RATIONALE: Virginia coastal communities face multiple challenges in their efforts to adapt to sea level rise, increased beach and wetland erosion, and flooding from heavy rain events and storm surges. These communities need to protect the value of their economic and community development infrastructure (e.g., tourism, port and maritime trades, military facilities, etc.), including transportation structures and amenities such as beaches. They also need to find ways of managing flood risks to protect residential areas and emergency response facilities. In some cases, where flooding is especially severe or frequent, there may be a need to relocate residences or public facilities. Private sector insurance companies are changing their policies to recognize the increased risk exposure of many land parcels, leaving large numbers of residential customers in these communities uninsured or dependent upon public insurance programs. Further, responsibilities and authority for responding to these challenges fall upon a wide array of public, private, and non-profit organizations at the local, state and federal level. Thus it is extremely difficult to make effective, generalized plans for change when each case of protection and adaptation involves such unique and specific site conditions and agency jurisdictions.

| **Progress** | |
| **Summary** | |

Hazard Resilient Coastal Communities (HRCC) Project Reports FY13

Program	VA
Project Title	Virginia Sea Grant Climate Adaptation Capacity Building Initiative
Investigators	Troy Hartley (Virginia Sea Grant);
Partner	
Description	OBJECTIVES: VASG aims to provide coastal communities with sufficient information to consider alternatives, enable them to make better informed decisions, and ultimately develop and implement customized solutions to the hazards and climate change challenges which threaten their economic, environmental and social well-being through two community and VASG capacity-building activities: 1) Faculty-student technical assistance on adaptation to sea level rise for Virginia's coastal communities; and 2) Staff capacity to support a growing Hampton Roads Adaptation Forum, advancing a knowledge management network to spur innovation and adoption of adaptation best practices. METHODOLOGY: VASG will leverage and expand existing capacity in the VASG network of partner academic institutions to support two program areas. (1) VASG-University of Virginia (UVA) Faculty-Student Technical Assistance. The UVA VASG Faculty-Student Technical Assistance will be conducted through a collaborative project with a coastal community client (e.g., municipality, regional planning district, private sector, etc.) who jointly define the scope of the project, dedicated graduate courses focusing on the climate adaptation project, and a comprehensive knowledge management system and approach that complements ongoing and emerging projects in the Virginia coastal zone, and shares lessons learned and materials to replicate activities broadly throughout the Mid-Atlantic and beyond. See attached work plan for more details. (2) VASG-Old Dominion University Hampton Roads Forum. Shortly, VASG will be awarded a National Sea Grant Office (NSGO) Community Climate Adaptation Initiative 2011 grant with our partner academic institution, Old Dominion University (ODU). The VASG-ODU Hampton Roads Forum project will address the Hampton Roads climate adaptation challenge by building local adaptation capacity among engineers, planners, facility managers, etc. In support of the VASG-ODU Hampton Roads Forum, ODU has a pending internal request for $50,000 toward a joint ODU-VASG permanent staff member to advance implementation of projects emerging from the Forum. VASG proposes to use a portion of the NSGO Climate Adaptation Capacity Building Initiative to leverage and support the ODU-VASG staff position. If the internal ODU staff position is not approved by ODU administration, VASG will provide additional funds to the UVA partnership to enhance its integration with and support of the NSGO Community Climate Adaptation Initiative-funded VASG-ODU Hampton Roads Forum. RATIONALE: Virginia coastal communities face multiple challenges in their efforts to adapt to sea level rise, increased beach and wetland erosion, and flooding from heavy rain events and storm surges. These communities need to protect the value of their economic and community development infrastructure (e.g., tourism, port and maritime trades, military, etc.) that will be affected by flooding and erosion, including

	transportation structures and amenities such as beaches. They also need to find ways of managing flood risks to protect residential areas and emergency response facilities. In some cases, where flooding is especially severe or frequent, there may be a need to relocate residences or public facilities. Private sector insurance companies are changing their policies to recognize the increased risk exposure of many land parcels, leaving large numbers of residential customers in these communities uninsured or dependent upon public insurance programs that provide fewer guarantees. It is difficult to make generalized plans for change when each case of protection and adaptation involves unique and specific site conditions.
Progress	
Summary	

Program	VA
Project Title	Faculty-Student Technical Assistance on Adaptation to Sea Level Rise for VA Communities
Investigators	Timothy Beatley (University Of Virginia, Charlottesville (UVA));
Partner	
Description	OBJECTIVES: Expected Outcomes: (1) tailored climate adaptation design and planning options that meet the needs of specific coastal community clients in the vulnerable Virginia coastal zone; (2) expanded future design and planning professionals workforce with climate adaptation capacity; and (3) expanding knowledge management repository for information transfer and adoption beyond the particular coastal community client, to the state and region. Performance Metrics: (1) one coastal community will be provided with innovative climate adaptation design and planning tools, techniques, and best practices; (2) over fifty communities will utilize the web-based repository by YR2 to access tools, techniques, and best practices; and (3) broader Hampton Roads community will share and adopt at least one tool, technique or best practice. METHODOLOGY: The UVA VASG Faculty-Student Technical Assistance will be conducted through a collaborative project with a coastal community client (e.g., municipality, regional planning district, private sector, etc.) who jointly define the scope of the project, dedicated graduate courses focusing on the climate adaptation project, and a comprehensive knowledge management system and approach that complements ongoing and

	emerging projects in the Virginia coastal zone, and shares lessons learned and materials to replicate activities broadly throughout the Mid-Atlantic and beyond. RATIONALE: Virginia coastal communities face multiple challenges in their efforts to adapt to sea level rise, increased beach and wetland erosion, and flooding from heavy rain events and storm surges. These communities need to protect the value of their economic and community development infrastructure (e.g., tourism, port and maritime trades, military, etc.) that will be affected by flooding and erosion, including transportation structures and amenities such as beaches. They also need to find ways of managing flood risks to protect residential areas and emergency response facilities. In some cases, where flooding is especially severe or frequent, there may be a need to relocate residences or public facilities. Private sector insurance companies are changing their policies to recognize the increased risk exposure of many land parcels, leaving large numbers of residential customers in these communities uninsured or dependent upon public insurance programs that provide fewer guarantees. It is difficult to make generalized plans for change when each case of protection and adaptation involves unique and specific site conditions.
Progress	
Summary	

Program	WA
Project Title	Washington Blue Ribbon Panel on Ocean Acidification
Investigators	Dalton, Penelope (University of Washington (UW));
Partner	
Description	In December 2011, Governor Christine Gregoire convened a Blue Ribbon Panel to address the effects of ocean acidification on Washington's shellfish resources. The need for additional research and policy development has been underscored by a recent crisis in larval supplies for the Northwest shellfish industry linked to acidified marine waters. The Panel was convened under the auspices of the Washington Shellfish Initiative, a regional partnership created to implement the National Oceanic and Atmospheric Administration (NOAA) National Shellfish Initiative. Following the announcement, Dr. Jane Lubchenco, NOAA Administrator, wrote to the Governor expressing strong support for both the

	Shellfish Initiative and Panel. The Blue Ribbon Panel is comprised of scientific experts, public opinion leaders, state, federal, tribal, and local policy makers, and industry representatives. The Panel will point the way to advanced scientific understanding of the effects of ocean acidification and will help shape Washington's response to the problem, strengthening the link between science and effective natural resource management. It will make recommendations to the Governor and Administrator, regional research groups, and other policy-makers, regarding additional research and monitoring needs and actions to understand, prevent, mitigate, and adapt to acidification of Washington's marine waters. The Panel is being led by its two co-chairs, William Ruckelshaus and Jay Manning, and supported by a dedicated facilitator and a staff coordinator. NOAA representatives on the Panel include Richard Feeley of the Pacific Marine Environmental Laboratory and Shallin Busch of the Northwest Fisheries Science Center. In addition, several Sea Grant-supported scientists have been appointed to the Panel to provide technical expertise.
Progress	Relevance: Powerful upwelling and offshore winds bring carbon dioxide-laden deep water to Washington's coast, and land-based nutrient runoffs and discharges produce more dissolved CO_2. The resulting corrosive, low-carbonate waters have been implicated in oyster larvae die-offs, jeopardizing Washington's $108 million shellfish industry. Impacts on other marine organisms and ecological communities are beginning to be documented as well. Response: Washington Sea Grant has awarded more than $1 million for field and laboratory research into acidification's effects on shellfish and on the zooplankton base of the marine food chain. The WSG-organized Symposium on Ocean Acidification in November 2011 provided an impetus for Governor Chris Gregoire to establish the Washington State Blue Ribbon Panel on Ocean Acidification, the first such state response nationwide. Sea Grant staff worked with the governor's office to identify panel members and obtained and administered panel financial support. WSG also coordinated the panel's logistics and proceedings and its working groups on science, adaptation and remediation, and education and outreach. Staff oversaw the preparation of the comprehensive science summary and materials for the final report and its public release in November 2012 Results: The report spurred substantial executive and legislative initiatives and brought national attention and extensive media coverage to the acidification issue. Gov. Gregoire directed state agencies to implement the panel's recommendations and included $3.3 million for acidification research in the state budget. A panel member introduced legislation to create a state board coordinating acidification research and action and authorize rural sewer systems to capture acidifying wastes. Responding to the governor's executive order, the U.S. EPA set out to review its criteria for water-body impairment and perhaps recognize acidification.
Summary	Recap: Washington Sea Grant plays a central role in Washington's Blue Ribbon Panel on Ocean Acidification, which leads to potential state and national action to curb acidification.

Program	WA

Project Title	Successful Adaptation: Identifying Effective Process and Outcome Characteristics and Practice-Relevant Metrics
Investigators	Snover, Amy (University of Washington, Climate Impacts Group, JISAO, College of the Environment (UW));
Partner	
Description	Objectives : What is successful adaptation to climate change in the coastal context? This is a question we are frequently asked by practitioners, yet one that has no easy scientific or political answers. While adaptation is increasingly recognized as an important climate risk management strategy, and on-the-ground adaptation planning activity is beginning to emerge everywhere, resource managers and planners have no clear guidance as to what success would look like. Success raises vexing management challenges and complex scientific questions about how to identify desirable outcomes and mechanisms across spatial/temporal scales, ecological systems, and social strata. Our project will address these questions by engaging scientists and coastal practitioners in an iterative, collaborative exploration of adaptation outcomes, processes and mechanisms, and the metrics with which to measure success in coastal communities in California, Oregon and Washington. The proposed project will contribute to Sea Grant's cross-cutting goals by integrating multi-disciplinary scientific and practitioner expertise to facilitate social learning and improve the management of coastal human-natural systems under rapidly changing conditions. We believe that makes this project exemplary of Sea Grants guiding principles applied toward one of its core research and management priorities. Managing the impacts of climate change and sea-level rise on coastal resources is a major concern in all three states; this work will assist the states in their efforts to develop regionally-integrated and locally appropriate state-based adaptation strategies, as well as provide needed guidance for local coastal practitioners across the region. The project will not only answer a pressing fundamental and use-inspired science question for the coastal sector, but contribute to regional management priorities and the national, multi-sector assessment and capacity-building effort of the Third National Climate Assessment. Methodology: We aim to develop guidance for coastal practitioners on the characteristics of successful adaptation to climate change in the coastal environment, in terms of (1) outcomes and (2) processes, governance and social mechanisms. We will use literature and policy reviews, interviews, and workshops with both scientists and practitioners, separately and combined – to create scientificallygrounded, practice-relevant indicators and metrics of success in both categories. Reviews of scientific literature on such topics as climate change adaptation, coastal hazards, resilience, and integrated coastal zone management, and of planning and policy documents related to adaptation, coastal hazards management, and disaster risk reduction will provide a foundational synthesis of current thinking that will be expanded, augmented, and ground-truthed by project participants. Workshop participants will work towards a common understanding of desirable adaptation outcomes, while explicitly addressing some of the most persistent, vexing challenges of coastal zone management (e.g., public vs. private rights and responsibilities; ecological

	vs. human needs; near- vs. longer-term objectives). The resultant contradictions and conflicts raise the question of successful institutional, policy and social mechanisms that allow for adjudication, compensation and acceptance, as well as process questions on how to conduct adaptation planning and decision-making to minimize anticipated conflicts. Qualitative analysis of discussions will use the conceptual adaptation frameworks of Eakin et al. (2009) and Pelling (2011) to assess how the characteristics of successful adaptation identified by scientists and practitioners are influenced by their interpretations of adaptation. Policy-relevance and policy-application will be insured by careful participant selection and engagement of project personnel in regional policy, planning, training and outreach processes before, during, and after the project. Rationale: Climate change will have widespread environmental, economic and social impacts, forcing coastal communities to face difficult choices and trade-offs in the decades ahead. Managing the impacts of climate change and sea-level rise on coastal resources is a major concern in all three West Coast states; state agencies and governors have publicly acknowledged the need for adaptation and begun to develop strategies to manage the effects of climate change, as have many local, tribal and federal entities. In this context, practitioners increasingly ask one big and difficult question: What would successful adaptation to climate change look like? Arguably, rather little has been said to date that would satisfactorily answer it. We aim to develop some answers through the iterative engagement of scientists and practitioners, and share them with those asking these questions across the West Coast and the nation. These answers are essential for the success of existing and future adaptation efforts at the local to national scales, and for the success of Sea Grant's core vision of people living along our coasts in harmony with the natural resources that attracted and sustain them. The proposed qualitative, multi-stage approach is reflective of the early state of understanding of adaptation success and of our commitment to policy-relevant science. It draws on existing knowledge, resting in science, policy documents, and in the experience of coastal practitioners to produce results, including a sophisticated articulation of what types of outcomes and process characteristics would be desirable (generically, or for particular stakeholders), and why; guiding principles on evaluating adaptation options; and practical success metrics. Project beneficiaries include regional policymakers, coastal practitioners and stakeholders; national coastal stakeholders and adaptation professionals; local, state, federal and tribal policymakers; National Climate Assessment and other adaptation groups.
Progress	Relevance: Climate change will have widespread environmental, economic and social impacts, forcing coastal communities to face difficult choices and trade-offs in the decades ahead. To prepare for a changing climate, resource managers and planners have increasingly asked, "What are the goals of adaptation? What would successful adaptation to climate change look like? How do we know if we're making progress?" Response: The four West Coast Sea Grant programs are supporting a joint effort to engage scientists and coastal practitioners in answering those questions. The project will develop a deeper understanding of what successful adaptation to climate change would mean in the various physical, ecological, socioeconomic, institutional and cultural contexts that characterize coastal communities. It will also define ways communities can measure their progress toward successful adaptation, both in the near term and as the climate continues to change. Results: Researchers have synthesized current thinking on successful adaptation in the

	published literature and are leading workshops with scientists and state coastal practitioners engaged in adaptation. The workshops are examining successful adaptation principles, outcomes and processes, both in theory and in practice, and have initiated a conversation that will continue through the rest of the project.
Summary	Recap: West Coast Sea Grant-funded researchers are engaging leading scientists and practitioners in the development of guidelines and metrics for measuring successful adaptation to climate change.

Program	WHOI
Project Title	End-User engagement for improved projections of local sea-level change and tropical cyclone activity
Investigators	Gregory Berman (Woods Hole Oceanographic Institution Sea Grant (WHOI)); Jeffrey Donnelly (Woods Hole Oceanographic Institution (WHOI));
Partner	Barnstable County Cape Cod Cooperative Extension; Woods Hole Oceanographic Institution (WHOI);
Description	(22) OBJECTIVES: To provide regional and local predictions of future coastal storm activity and sea-level rise to users of our nation's and, in particular, our region's marine and coastal resources in order to promote wise utilization and conservation of those resources. This project will assist in developing reciprocal relationships between resource users/managers and technical information producers in order to facilitate end-user engagement informed tools for users/managers of those resources. (23) METHODOLOGY: As part of this effort tropical cyclone downscaling modeling within projected future climate scenarios simulated by the suite of IPCC AR5 models will be used to estimate the probability of future tropical cyclone impacts. Hydrodynamic modeling of hurricane surges will be used to assess future probabilities of tropical cyclone-induced inundation. The funds requested here will support the development of data visualization products and to help facilitate dialog with end-users through workshops. The probabilistic results pertaining to tropical cyclone-induced inundation will be integrated with estimates of future local changes in sea level and synthesized into tools tailored for planners and managers. We will develop graphics and a web-based data visualization scheme to help disseminate our results to end users. In addition, we will develop a web-based tutorial to educate end users about our research approach and design. In order to facilitate the transition of our results into user friendly tools we are requesting funds to assist in building a GIS-based geospatial archive of the tropical cyclone inundation scenarios. A key component of the project is to engage end users through a series of workshops so as to better inform the science needs, including matching the time scales of our analysis with those necessary for decision making. (24) RATIONALE: This project exemplifies the path defined by the Mission of NOAAs Next Generation Strategic

	Plan: "To understand and predict changes in climate, weather, oceans, and coasts; to share that knowledge and information with others, and to conserve and manage coastal and marine ecosystems and resources." Information desired by our stakeholders will be made available by providing this extension component to the currently NOAA funded project "Advanced Regional and Decadal Predictions of Coastal Inundation for the U.S. Atlantic and Gulf Coasts"
Progress	
Summary	

Program	WI
Project Title	Great Lakes Coastal Storms Program - Outreach Coordinator - Coastal Hazards Planning and Mitigation
Investigators	David Hart (Wisconsin Sea Grant); Philip Moy (Wisconsin Sea Grant);
Partner	
Description	There are several ongoing projects in the Great Lakes region designed to improve the safety of coastal communities and minimize the negative impacts of coastal storms. The largest include the Great Lakes Coastal Flood Study led by the Federal Emergency Management Agency (http://www.greatlakescoast.org/), the Upper Great Lakes Study sponsored by the International Joint Commission (http://www.iugls.org/), and the Great Lakes Coastal Resilience Project coordinated by the NOAA Coastal Services Center's Digital Coast Partnership (http://floodatlas.org/GLRI/). In addition, there are many state efforts and smaller-scale regional activities related to coastal hazard planning and mitigation (see Appendix A). It will be important for the Coastal Storms Program to collaborate closely with these efforts to avoid duplication of effort and leverage NOAA Coastal Storms Program products, methods, and data in community outreach activities. An outreach coordinator with expertise in community planning and coastal flood hazard mitigation will be hosted by the University of Wisconsin Sea Grant College Program, likely in the Green Bay or Milwaukee field office. UW Sea Grant would provide at least half of the support for this position during the two-plus year tenure of the Coastal Storms Program and intends to ontinue support beyond the end of the project. The outreach coordinator would work closely with the Association of State Floodplain Managers (ASFPM) based in Madison, Wisconsin and the American Planning Association (APA) based in Chicago, Illinois. ASFPM is a national professional organization with the mission of promoting

	education and policies that mitigate losses caused by flooding, and to protect the natural and beneficial functions of floodplains – all without causing adverse impacts. They provide outreach for the FEMA Great Lakes Coastal Flood Study and are leading the Great Lakes Coastal Resilience Project for the Digital Coast Partnership. APA provides leadership in the development of vital communities by advocating excellence in community planning, promoting education and citizen empowerment, and providing the tools and support necessary to meet the challenges of growth and change. They have an active research agenda addressing coastal hazards and are also active in the NOAA Digital Coast Partnership. Objective: By 2015, Great Lakes coastal communities will utilize effective comprehensive, mitigation, and climate adaptation plans and multi-objective management to promote resilience to coastal hazards and address problems from coastal storms before they become disasters. The coordinator based in Wisconsin would provide outreach and technical assistance throughout the Great Lakes basin. The coordinator would also work with the other Coastal Storm Program coordinator(s) in the Great Lakes to assure that the efforts are truly Great Lakes basin wide. Specific objectives and action items include: 1. providing training to improve knowledge about coastal flooding hazards and the capabilities of the Coastal Storms Program among outreach specialists in the Great Lakes Sea Grant Network; 2. assessing the needs of Great Lakes coastal communities for products that reduce the negative impacts from coastal storms; 3. development of comprehensive plans that address reduction of coastal hazards; 4. development of hazard mitigation plans that embrace the "no adverse impacts" guidelines developed by ASFPM; 5. promoting the development of climate adaptation plans by coastal communities; 6. advocating for effective implementation of comprehensive, hazard mitigation, and climate adaptation plans; 7. advancing adaptive management principles recommended in the Upper Great Lakes Study; 8. applying spatial decision support tools to address coastal hazards that leverage state coastal atlases/GIS, the Great Lakes Observing System, and the Digital Coast.
Progress	
Summary	

Program	GA
Project Title	Improving Inundation Forecasts through Post-storm Assessments
Investigators	Charles Hopkinson (Georgia Sea Grant); Darin Figurskey (National Weather Service (US DOC, NOAA, NWS)); Geno Olmi (Coastal Services Center (US DOC, NOAA, NOS, CSC)); Richard Bandy (National Weather Service (US DOC, NOAA, NWS));

Partner	Coastal Services Center (US DOC, NOAA, NOS, CSC); National Weather Service (US DOC, NOAA, NWS);
Description	Objectives: 1. To begin the creation of a network of "volunteer" observers to capture inundation heights and extents and information (including pictures) on impacts 2. To save lives and property through improved storm surge inundation forecasts and understanding of impacts. Methodology: This project will begin creation of a network of "volunteer" observers to capture inundation heights and extents and information (including pictures) on impacts. In a workshop, we will bring together people in the storm surge modeling, measuring, and forecasting communities in the Southeast and Caribbean region for a scoping workshop to identify needs, opportunities, and constraints for providing inundation information. Following the workshop, the project team will work to implement the plan developed at the workshop. Rationale: Coastal areas are especially vulnerable to flooding from hurricanes, tropical storms and strong extra tropical low pressure systems. Storm surge is often the greatest threat to life and property from a tropical cyclone. Much of the United States' densely populated Atlantic and Gulf of Mexico coastlines lie less than 10 feet above mean sea level, and over half of the nation's economic productivity is located within coastal zones. Because of the significant risk to lives and property from inundation (including total water level resulting from tide, storm surge, wave run up, and freshwater runoff combined), accurately forecasting such events are critical. This project will contribute to the ongoing development and validation of storm surge models, specifically in developing an observation network to augment data on surge heights and extent.
Progress	
Summary	

Program	IL-IN
Project Title	SG-Community Adaption and Mitigation for Climate Change
Investigators	Martin Jaffe (IIllinois-Indiana Sea Grant);
Partner	Illinois State Water Survey; National Oceanic and Atmospheric Administration (US DOC, NOAA);
Description	Illinois-Indiana Sea Grant (IISG) will collaborate with the Midwestern Regional Climate Center (MRCC) to develop

	additional climate expertise for climate adaptation and mitigation activities, leveraging Sea Grant's expertise in planning and outreach, and providing MRCC expertise in climate science. The MRCC is a cooperative program of the Illinois State Water Survey (University of Illinois) and the National Climatic Data Center (NOAA). We propose to focus on areas related to community climate adaptation and climate literacy.
Progress	
Summary	

Program	MD
Project Title	Seasonal Trend, Source Appointment, Spatial Budjet, and In-Stream Cycling of Nutrient and Sediment from the Susquehanna River Basin to the Chesapeake Bay
Investigators	William Ball (Johns Hopkins University (JHU));
Partner	
Description	Objectives: Reduction of nitrogen, phosphorus, and suspended sediment load has been a principal focus of Chesapeake Bay Watershed management for decades. It is thus important to evaluate the progress of historical management plans and propose adaptive refinement options for future management plans. In the Chesapeake Bay Watershed, the Susquehanna River is the largest tributary in terms of both freshwater and nutrient inputs. In this context, the first objective of this project is to apply the most up-to-date loading estimation method, called the "weighted regression on time, discharge, and season", to reconstruct the longterm seasonal trends of nitrogen, phosphorus, and suspended sediment at various monitoring sites in the Susquehanna River Basin. Using such load estimates, the second major objective is to quantitatively examine the source apportionment, spatial budget, and in-stream cycling of these species in the Susquehanna River Basin, as well as impacts of stormflows on these processes. Methodology: We will estimates the seasonal loads and trends of various nutrient and sediment species at all long-term monitoring sites in the Susquehanna River Basin using the most up-to-date loading estimation method. This method can produce (a) true-condition estimates that can help understand the real history of nutrient (or sediment) and downstream ecological impact, and (b) flow-normalized estimates that can greatly remove the dramatic influence of random variations in streamflow and reveal more clear interannual trend. Using such load estimates, we will proceed to investigate the

	source apportionment, spatial budget, and in-stream cycling of these species. Specifically, we will (1) use load apportionment method to distinguish point and nonpoint contributions, (2) develop load budget for each species to separate the input from each sub-basin, and identify the critical source areas under stormflow conditions, and (3) examine the temporal and spatial variations of dissolved and particulate nitrogen and phosphorus species, and the impacts of stormflows on the speciation of nitrogen and phosphorus. Rationale: This project will reveal the long-term seasonal trends of nutrient and sediment species in the Susquehanna River using the most-up-to-date estimation method. The estimated loadings and trends can be shared with target audiences, including federal and state regulatory agencies, groups impacted by total maximum daily load allocation, and the broader scientific community. In addition, this project will help understand the source apportionment, spatial budget, and in-stream cycling of nutrient and sediment species, as well as impacts of stormflow on these processes. Overall, these findings can facilitate managers to adaptively refine the management plan by making "science-based decisions" that "consider how and when conservation and restoration efforts can be most effective" – as acknowledged by "Focus Area 1: Resilient Ecosystem Processes and Responses" of the Maryland Sea Grant Strategic Plan. Finally yet importantly, this project will create benefits by serving as an exemplary prototype for follow-up work on the other tributaries of Chesapeake Bay.
Progress	RELEVANCE: In an era with innumerable environmental issues, it is important for society to have highly trained scientists with excellent research capabilities and the ability to communicate science with broader audiences. RESPONSE: Maryland Sea Grant conducted a one-time graduate fellowship competition during 2012 that will provide full support and tuition remission to graduate students in marine science and related areas for up to two years. Fellowship recipients will conduct research on a topic related to one of Maryland Sea Grant's focus areas and receive training in science communication, the process of applying scientific findings to management of natural resources, and other relevant Sea Grant activities. RESULTS: Maryland Sea Grant conducted a competitive Request for Proposals during 2012 and selected five highly qualified graduate students for fellowships. Fellows participated in an orientation with Maryland Sea Grant Extension staff members designed to strengthen the outreach components of their research projects. Each fellow also identified an "end user mentor" who will meet regularly with the fellow and help select and develop appropriate outreach mechanisms for disseminating and applying his or her research. Fellows will conduct projects on stream restoration design, food web dynamics in plankton, nutrient dynamics modeling in the Chesapeake Bay, feeding ecology in fisheries, and riparian buffer modeling.
Summary	Maryland Sea Grant conducted a special competition to support graduate fellows conducting research in Maryland's coasts and watersheds. The program was designed to enhance fellows' understanding of scientific outreach through workshops, meetings, and othe

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Program	MD
Project Title	The effect of Climate Change to the Coastal Bay Water Quality
Investigators	Meng Xia (University of Maryland Eastern Shore (UMES));
Partner	
Description	Objectives The main goals of this study are to define the general pattern of the Maryland Coastal Bays system and provide important information for the 3-D bay circulation and Dissolved Oxygen Dynamics using a numerical modeling simulation component. Specifically, our objectives include: To investigate spatial and temporal characteristics of physical properties of the Maryland Coastal Bays. To understand as much as possible the major mechanisms controlling hydrodynamics in the shallow water systems such as bay-ocean salinity transport. To identify the how climate change (sea level rise, global warming) influence the bay circulation and Dissolved Oxygen. Methodology The numerical model to be used in Maryland Coastal Bays system is called ELCIRC, an unstructured grid model developed specially for the bay, estuarine and coastal ocean. The salient feature of the model is that it uses a combination of triangular and quadrilateral unstructured grid to revolve the coastline and channel geometry. In addition, the model is capable of simulating the wetting-and-drying process, which is a common feature occurring in the shallow coastal system. The model is a general three-dimensional model capable of simulating both 2-dimensional (vertically averaged) and 3-dimensional hydrodynamics and transport processes. In the horizontal, the model uses anorthogonal, unstructured grid with mixed triangular and quadrilateral grids and the sigma-coordinate in the vertical. For a detailed description of the ELCIRC model, the reader is referred to Zhang and Baptist (2005). The modeling grid is depicted in figure 2. Water Column Eutrophication Model. A three-dimensional time-variable eutrophication model package called Water Quality Integrated Compartment Model (CE-QUAL-ICM) has been selected for use in the Maryland Coastal Bay system study. The model includes both the water column eutrophication process and the benthic sediment process, which are dynamically coupled with hydrodynamic and watershed models. The US Army Corps of Engineers originally developed the model for the EPA Chesapeake Bay Program by in the Chesapeake Bay study. The water column eutrophication model solves the mass-balance equation for each state variable and for each model cell. A detailed description of the water column eutrophication model can be found in Cerco and Cole (1994). Rationale Given the Coastal Bays system's highly productive and valuable ecosystem that is under increasing stress from both anthropogenic and natural disturbances, a high resolution numerical model will be used to understand the bay circulation under the effect of climate change. This model will provide the best chance to develop a tool for synthesizing the multi-stressors existing in the system, simulating the direct and indirect response linking climate change, freshwater inflow.
Progress	

Summary	

Program	MS-AL
Project Title	Assessing Vulnerabilities to Climate Related Stressors in Orange Beach, Alabama
Investigators	
Partner	
Description	
Progress	Relevance: A comprehensive vulnerability assessment of a community is needed to determine baseline data to prepare for future conditions. Changing climate conditions, such as sea-level rise, heavy precipitation and greater intensity of storms, can exacerbate storm situations. Response: Sea Grant worked with the City of Orange Beach to organize a Vulnerability-Consequence Adaptation Planning Scenarios (VCAPS) workshop. Results: During this workshop, members from the City of Orange Beach and neighboring cities within the watershed, developed an action plan for responding to increased heavy precipitation events and greater intensity storm events. These actions were incorporated into an updated Emergency Operations Plan that was adopted by the city.
Summary	Recap: The City of Orange Beach adopted a new Emergency Operations Plan as a result of the vulnerability assessment workshop conducted in partnership with Sea Grant.

Program	NY
Project Title	Observations for evaluating the breach at Old Inlet caused by super-storm Sandy

Investigators	Charles Flagg (Stonybrook University, Marine Sciences Research Center);
Partner	National Park Service (US DOI, NPS); State University of New York, Stony Brook (SUNY);
Description	The purpose of this proposal is to begin the gathering of information needed to determine the potential evolution of the inlet, including whether it is likely to close on its own or expand further, and how that evolution will affect the tidal dynamics, and eventually the biota, of the eastern Great South Bay. First, we propose gathering bathymetric data to determine the morphology of the inlet area from the open ocean approach through the conveyance channels of the back bay. Second, we propose to install a sensor capable of measuring sea level, temperature and salinity for several months at a suitable location on the remains of the Old Inlet dock. And third, we propose to convert the existing SBE 16Plus at the Bellport marina to a real-time unit so that changes to sea level and tidal characteristics in the Bay can be constantly monitored.
Progress	Sea Grant funds research to investigate a barrier island breach formed by Sandy Hurricane Sandy opened a breach at Old Inlet on Fire Island, along Long Island's South Shore. NYSG funded this project to begin gathering the information needed to determine the potential evolution of the inlet, including whether it is likely to close on its own or expand further, and how that evolution will affect the tidal dynamics, and eventually the ecology, of the eastern Great South Bay. The research team will be gathering bathymetric data to determine the morphology of the inlet area from the open ocean through to the bay. The research team will also install a sensor capable of measuring sea level, temperature and salinity for several months at a suitable location at Old Inlet. A real-time telemetry unit will be used so that changes to sea level and tidal characteristics in the Bay can be constantly monitored. Information generated from this research will help NYSG address focus area of improved hazard resilience in New York coastal communities.
Summary	

Program	VA
Project Title	Virginia Coastal Policy Clinic: VASG Summer Legal Fellowships
Investigators	Shana Jones (College of William and Mary);
Partner	

Description	OBJECTIVES: Working in partnership with the Virginia Institute of Marine Science (VIMS) and VASG, VCPC integrates the latest science with legal and policy analysis to propose solutions to coastal resource management issues and to educate the Virginia policymaking, non-profit, legal, business, and military communities about these subjects. VCPC and VASG have shared goals and aim to leverage our capacities in coastal and marine resource law, policy, and science to achieve mutual benefits. The VCPC addresses the VASG Strategic Plan goal to "build coastal community capacity to prepare, adapt, and respond to climate change impacts and other natural and human hazards." METHODOLOGY: The Virginia Coastal Policy Clinic (VCPC) at William & Mary Law School will support two Summer VASG Fellowships for rising second and third-year law students. The students will: • Provide legal research and writing to complete the jurisdictional studies; • Conduct stakeholder interviews as necessary to complete the jurisdictional studies; • Develop robust content for breakout sessions related to the October 2013 Conference; • Provide much-needed assistance in planning and implementing the October Conference; and • Work with VASG as needed on discrete research projects deemed of interest to VASG and/or its affiliates and grantees. Moreover, the fellowships will provide law students with the opportunity to develop their research and writing skills, as well as be exposed to local, regional, and national experts in coastal and marine science and VASG experts. RATIONALE: The fellows will support the VCPC 2013 project, Protecting Virginia Localities from Sea Level Rise: Integrating Science and Law to Advance Informed Decision-making. As part of the project, VCPC plans to accomplish the following: 1. Study two Virginia jurisdictions greatly affected by sea level rise – Norfolk and Poquoson – to identify and analyze the most significant legal and policy issues they must consider in developing their coastal management strategy. 2. Instruct and direct VCPC's law students to use the jurisdictional studies to develop recommendations and possible adaptive strategies for Norfolk and Poquoson in meeting the legal and policy challenges created by sea level rise. 3. Convene a conference in fall 2013 bringing together local planners, Virginia policymakers, city and county attorneys, scientists, military leaders, and other stakeholders to respond to and discuss the legal and policy issues identified by VCPC in the studies of Norfolk and Poquoson, as well as to discuss the emerging challenges and barriers localities face in addressing these issues; and 4. Extend VCPC's reach by conducting external briefings and presenting programs at regional and statewide conferences, meetings and workshops to assist local communities and state policymakers in understanding the law, science and policy of sea level rise and of possible adaptive strategies.
Progress	
Summary	

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Program	WA
Project Title	Establishment of a Liaison between Washington Sea Grant and the Pacific Marine Environmental Laboratory
Investigators	Dalton, Penelope (University of Washington (UW));
Partner	Pacific Marine Environmental Laboratory (US DOC, NOAA, OAR, PMEL);
Description	The National Oceanic and Atmospheric Administration (NOAA) Office of Oceanic and Atmospheric Research is the administrative home to the National Sea Grant College Program and the Pacific Marine Environmental Laboratory (PMEL). Both organizations support world-class scientific research. Ongoing federal fiscal limitations highlight the need for NOAA to maximize the effectiveness of its research investments, both internally and with its academic partners. Through establishment of a liaison, Washington Sea Grant (WSG) and PMEL will coordinate work in the state and region on pressing marine issues relevant to both organizations, primarily tsunami hazards and ocean acidification. The relationship will enhance government and academic collaboration and the ability to share new scientific research and knowledge with stakeholders, including government agencies, academic institutions, tribes, marine industries and the public.
Progress	
Summary	